

American National Standard

Z39.50-1988

**Information
Retrieval
Service
Definition
and Protocol
Specifications
for Library
Applications**

NISO

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Information Retrieval Service and Protocol

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Information Retrieval Service and Protocol

American National Standard for Information Retrieval Service Definition and Protocol Specification for Library Applications

Abstract

This standard specifies an Open Systems Interconnection application layer service definition and protocol specification for Information Retrieval. The Information Retrieval protocol allows an application on one computer to query the database of another computer. The protocol specifies the procedures and structures for the intersystem submission of a search request (including the syntax of the query), request for the transmission of database records located by a search, the responses to the requests, access control, and resource control.

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Foreword

(This foreword is not part of American National Standard Z39.50-1988.)

This standard was prepared by Standards Committee D, "Computer-to-Computer Protocols," of NISO, the National Information Standards Organization (Z39). Standards Committee D was organized to develop protocols at the application layer of the Open Systems Interconnection (OSI) Reference Model (ISO 7498) of the International Organization for Standardization (ISO). Applications to be considered include information retrieval, inter-library loan, and the transfer of bibliographic and other types of database records. The committee has monitored the development by other standards bodies of related application protocols, including file transfer and message transfer.

This standard responds to a need for a protocol to exchange messages between two computers for the purpose of information retrieval: to enable a requesting computer to 1) request that the responding computer search a specified database, and identify records which meet specified criteria, and 2) request transmission of, and receive, some or all of the identified records.

The requesting and responding computers are referred to respectively as the origin and target. It is assumed that the origin initiates requests on behalf of a user who wishes to search a database located on the target system. This standard addresses the protocol between the corresponding information retrieval applications on the origin and target systems; it does not address the interaction between the origin computer and the user.

The protocol provides the following *basic* capabilities. Upon establishment of an "information retrieval" session (session establishment is outside the scope of this standard), the origin may submit a *Search* request which includes a query (discussed below) and parameters which determine whether or not the records resulting from the search are to be returned as part of the response. The target responds with a count of the records identified and possibly some or all of the records. The origin may then submit a *Present* request, requesting transmission of any number of the records. The origin assumes that the records selected by the search request form an ordered set which may be referenced by sequential position within the set. The ordering of the records is determined by the target system. The origin may request (for example) records one through four, and follow with a request for records four through eight, and then records two through three, etc. The origin may submit as many such *Present* requests as desired, and may then submit another *Search* request.

Optional capabilities include the following:

- (1) The origin may specify an *element set name* specifying the data elements that should be transmitted in cases where the origin does not wish to receive full database records.
- (2) The origin may *name* a result set so that it may be subsequently referenced by name.
- (3) The origin may *delete* a previously named result set.
- (4) The target may impose *access control* restrictions on the origin, by demanding authentication before processing a request.
- (5) The target may provide *resource control* by sending an unsolicited status report during processing of an operation, and allowing the origin to decide whether the operation should continue.

Aside from the basic and optional capabilities of the protocol, the *query* formulation

FOREWORD

presented special considerations for the committee. Various information retrieval systems formulate queries differently. The committee established the following guidelines:

1. Queries are transmitted according to a common format. Thus the origin is not responsible for translating its query structure to that of the target because that would require distinct translation capabilities for each system accessed. Instead, the origin translates to, and the target translates from, a common format.
2. The protocol provides and names one such format; additional formats can be subsequently named and added to the standard. Each search request specifies the name of the format of the query it contains.
3. A mechanism is provided to allow two systems to use a private, mutually agreed upon query format.

The "Type-1" query specified in this standard expresses queries by individual search terms (or phrases) with a set of attributes for each. Attributes may be defined to specify the type of term (e.g. subject, name, etc.), whether it is truncated, its position within a record, and so on. These attributes are not defined as part of the standard. Different terms may also be combined in one search via boolean operators. The Type-1 query requires that terms and operators be specified in Reverse Polish Notation (postfix operator notation), to make them unambiguously readable to the target system.

The Information Retrieval protocol provides for the transfer of database records identified by a search/retrieval request. Records are included within the response messages from the target and are preceded by a type and length. Although these type and length fields may be redundant for some applications, they are included in the message structure so that extraction of records from the message may be performed without knowledge of the internal record format.

The standard distinguishes two types of records (database records and diagnostic records) that can appear in response messages from the target system. There is a provision for defining other record types. Appendix D (which is not part of the standard) provides a sample format for diagnostic records. ANSI/NISO Z39.2-1985 specifies a format structure for the transfer of USMARC records that would be appropriate for use when the database on the target system contains bibliographic records.

The committee believes that the generality of the protocol will allow it to accommodate the addition of new services as required. Some issues that might be considered in the future are:

- List Databases: to obtain a list of the names of databases available to search on the target system
- List Access Points: to obtain a list of access points to records in specified database
- Browse: to obtain a list of access point values preceding and following a specified access value, or meeting other criteria
- Sort Result Set: to request that a result set be sorted in a specified order
- Save Result Set: to save and recall a result set across associations
- List Elements: to obtain a listing of the data elements contained in the records of the specified database
- Define Element Set: to define and name a set of elements (a subset of

the data elements contained in the records of the specified database) to compose a retrieval record

- List Element Set: to obtain a list of elements in a specified element set
- List Element Sets: to obtain a list of defined element sets
- Message Handling Services: mapping of this protocol onto Message Handling Services
- Embedding of Init: to map the Init and Init-response APDUs to the common application association control A-associate service
- Standardization of Data Structures: to standardize attribute lists for query types, diagnostic record formats, resource report formats, and additional query types
- Concurrency Control: interfaces to database concurrency control mechanisms, and the ability for an origin system to specify concurrency control options.

This standard was processed and approved for submittal to ANSI by the National Information Standards Organization (NISO). NISO approval of the standard does not necessarily imply that all NISO members voted for its approval. At the time it approved this standard, NISO had the following Voting Members:

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Information

1. Introduction

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This standard and is concerned databases.

1.1 Scope and application (section 4), for

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**American National Standard for
Information Retrieval Service
Definition and Protocol Specification
for Library Applications**

1. Introduction

This is one of a set of standards produced to facilitate the interconnection of computer systems. It is positioned with respect to other related standards by the Open Systems Interconnection (OSI) basic reference model (ISO 7498). The aim of Open Systems Interconnection is to allow the interconnection of computer systems, with a minimum of technical agreement outside the interconnection standards.

This standard defines a protocol within the application layer of the reference model, and is concerned in particular with the retrieval of information stored in machine readable databases.

1.1 Scope and Field of Application. This standard describes the Information Retrieval application service (section 3) and specifies the Information Retrieval application protocol (section 4), for Open Systems Interconnection.

The Information Retrieval application service is described in terms of services that provide capabilities within an application. The description neither specifies nor constrains the implementation within a computer system. The purpose of the service description is to define the functions that the protocol must support.

The protocol specification includes the definition of the protocol control information, the rules for exchanging this information, and the conformance requirements to be met by implementation of this protocol.

This standard is intended particularly for use in the area of library and information sciences. It addresses connection-oriented, program-to-program, communication utilizing telecommunications. It does not address the interchange of information with terminals or via other physical media.

1.2 Model. The objective of this standard is to facilitate the open interconnection of database users with database providers. It is necessary to distinguish between the set of OSI standards and the hardware and software implementation of a system using the protocols specified in these standards. The ways in which databases are implemented differ considerably; different systems have different styles for describing the storage of data and the means by which it can be accessed. A common, abstract model is therefore used in describing databases, to which an individual system can map its implementation. This enables different systems to communicate in standard, mutually understandable terms.

The term "database" as used in this standard refers to a collection of one or more files, each with a unique name. A group of files within a database may also have a name and be

accessed as a single database. The unit of information for retrieval from a database is a record. All of the records within a given file have a common structure, contain a common set of data elements and a common set of access points. An access point is a unique or non-unique key that can be specified either singly or in combination with other access points in a search for records. An access point may be equivalent to a data element, be derived from a data element, or be the combination of all or part of two or more data elements.

A search query may be applied to a database, specifying values to be matched against the access points of the database. The subset of records formed by applying the search query is termed the result set. A result set may itself be referenced in a subsequent search query statement and manipulated to form a new result set.

For generality, it is assumed that query processing does not necessarily require physical access to records; a result set is thus assumed to be the *identification of* (e.g., pointers to) records, as opposed to the actual set of records, selected by a query. (It is not assumed that the database records are locked. Methods of concurrency control, which would prevent modification or deletion of result set records, are not addressed by this standard.) A result set may be used as a selection mechanism for the transfer of records between systems; the result set itself is considered to be a purely local data structure and is not transferred (that is, records are transferred, but *not the local pointers* to the records).

A generic search query statement is composed of a database name followed by a query statement. The Type-1 query statement defined in this standard consists of either a single access point clause, or several access point clauses linked by logical operators. For example:

In the database which is named 'Books' find all of the records for which the access point 'title word' contains the value 'evangeline' AND the access point 'author' contains the value 'longfellow.'

Following the processing of a search, the set of items with the specified properties (the result set) is made available by the target system, to the origin system, for subsequent retrieval requests. The logical structure of a result set is that of a named, ordered list of triples consisting of (a) an ordinal number corresponding to the position of the triple in the list, (b) a database name, and (c) a unique record identifier (of local significance only) within the database named in (b). A result set item is referenced by its position within the result set, that is, by (a).

1.3 References

ISO 7498—Information Processing Systems-Open Systems Interconnection-Basic Reference Model

ISO 8649/2—Information Processing Systems-Open Systems Interconnection-Service Definition for Association Control

ISO 8822—Information Processing Systems-Open Systems Interconnection-Connection Oriented Presentation Service Definition

ANSI X3.4—Information Processing-Coded Character Sets-7-bit American National Standard Code for Information Interchange (7-bit ASCII)

2. Definitions

In the following definitions, the terms "information" and "record" are used in the sense of the document.

ADPU—See ADPU

Application—A process formed by the user presentation of data

For the
definition
of the
origin
system

Application—The connection.

Application—The communication.

The
origin

Application—The using a process

The

Application—The and controlling

A

Application—The Open System

The
process

Connection—The is explicitly explicitly

2. Definitions

In the following cases where formal definitions are given, descriptions and alternate definitions (indented) are sometimes provided. Alternate definitions apply only to the Information Retrieval application service and protocol, and only within the context of this document.

ADPU—See Application Protocol Data Unit.

Application Association—A cooperative relationship between two application-entities, formed by their exchange of application-protocol-control-information through their use of presentation-services.

For the Information Retrieval service and protocol, an application association is analogous to an individual communication session between a database user and a database provider. Each association consists of an origin application and a target application, and these roles may not be reversed within an association.

Application Entity—The aspects of an application process pertinent to Open Systems Interconnection.

Application Protocol—A set of rules and formats, semantic and syntactic, which determines the communication behavior of application entities in the performance of application functions.

The rules governing the format and exchange of information between an origin and target application.

Application Protocol Control Information—Information exchanged between applications, using a presentation connection, to coordinate their joint operation.

The information conveyed by application protocol data units.

Application Protocol Data Unit—A unit of information specified in an application protocol and consisting of application protocol control information.

A unit of data passed between an origin and a target.

Application Service User—That portion of an application which makes requests upon the Open Systems Environment.

(The concept of service-user is employed to facilitate the specification of protocol procedures and is not analogous to the database user.)

Connection Oriented Communication—Communication in which the communication path is explicitly established for an association, maintained throughout the association, and explicitly terminated.

Database Provider—The application that provides access to a database local to that application.

Database User—The application that accesses a remote database.

Name—A linguistic construct, expressed in some language, which corresponds to an object. A name denotes (i.e., identifies) the object to which it is bound.

Origin Application—The application that initiates an association and is the source of requests during the association.

The database user.

OSI—Open Systems Interconnection.

Primitive—An abstract element of interaction between service-user and service-provider.

Result Set—An ordered list of triples consisting of (a) an ordinal number corresponding to the position of the triple in the list, (b) a database name, and (c) a unique record identifier (of local significance only) within the database named in (b). A result set is formed by applying a search query.

Service Provider—The provider of communication service between two service users.

(The concept of service-provider is employed to facilitate the specification of protocol procedures. It is not analogous to the database provider, and it does not refer to providers of telecommunication services.)

Target Application—The application that accepts an association and is the sink for requests during the association.

The database provider.

Primitive Name—A kind of name, the internal structure of which is not required to be understood or have significance to users of the name.

3. Information Retrieval Service

This section defines the Information Retrieval service, which is supported by the Information Retrieval protocol.

3.1 General Characteristics of the Information Retrieval Service. The service definition describes an activity between two applications on different computers: an initiating application, the origin, and a responding application, the target. The target is associated with one or more databases. Communication between origin and target is via an application association. An association is explicitly established by the origin and may be explicitly terminated by

either origin or target event.

The request cannot be terminated.

The communication control service phases during termination of application association during the request services for user.

3.2 Facilities of standard. All consists of two

either origin or target, or implicitly terminated by a communication failure or other external event.

The roles of origin and target may not be reversed within an association. An association cannot be restarted; thus no status information is retained once an association is released.

The complete application service is composed of the common application association control service, which provides association management, and one or more specific application services, such as the Information Retrieval application service. There are three distinct phases during the life of an application association: establishment, information transfer, and termination. The common application association control service provides all of the services required during the establishment and termination phases, including the selection of an application context specifying, among other things, the set of service elements that are valid during the information transfer phase. Section 4.2.1.2 specifies those common application services for association control that are assumed by the Information Retrieval service.

3.2 Facilities of the Information Retrieval Service. There are seven facilities defined by this standard. All consist of a single service element, except the Termination facility, which consists of two service elements.

- (1) Initialization Facility
Init Service Element: Init request from the origin followed (possibly after one or more intervening Access-control and/or Resource-control request/response sequences) by an Init response from the target.
- (2) Search Facility
Search Service Element: Search request from the origin followed (possibly after one or more intervening Access-control and/or Resource-control request/response sequences) by a Search response from the target.
- (3) Retrieval Facility
Present Service Element: Present request from the origin followed (possibly after one or more intervening Access-control and/or Resource-control request/response sequences) by a Present response from the target.
- (4) Result-Set-Delete Facility
Delete Service Element: Delete request from the origin followed (possibly after one or more intervening Access-control and/or Resource-control request/response sequences) by a Delete response from the target.
- (5) Access Control Facility
Access-Control Service Element: Access-control request by the target, following an Init, Search, Present, or Delete request by the origin, or following a Resource-control or Access-control request/response sequence, and followed by an Access-control response from the origin.
- (6) Accounting/Resource Control Facility
Resource-Control Service Element: Resource-control request by the target, following an Init, Search, Present, or Delete request by the origin, or following a Resource-control or Access-control request/response sequence, and followed by a Resource-control response from the origin.

(7) Termination Facility

The Termination Facility allows an origin or target system to initiate abrupt termination of the association, or an origin system to initiate graceful termination.

IR-Abort Service Element: IR-abort request by either the origin or the target.

IR-Release Service Element: IR-Release request by the origin followed by an IR-Release response by the target.

The IR-Abort and IR-Release services map directly onto the A-ABORT and A-RELEASE services (respectively) of the common application association control services.

3.2.1 Initialization Facility

3.2.1.1 Init Service Element. The Init service element allows an origin to propose values for initialization parameters. The target system may propose alternative values for some of the parameters. If so, the origin must either accept the alternative values proposed by the target or else terminate communication.

3.2.1.1.1 ID/Authentication. The origin and target agree, outside the scope of the standard, whether or not this parameter is to be supplied by the origin, and if so, what the value is. This value is used by the target to determine if the origin is authorized to enter into communication with the target.

3.2.1.1.2 Options. The Init request specifies either "will use" or "will not use," and the Init response specifies "will support" or "will not support" for the following capabilities:

1. search
2. present
3. delete.

If the request specifies "will not use" for a particular capability, then the origin should ignore the value in the response for that capability.

Table 1
Parameters of the Init Service Element

| PARAMETER | ORIGIN REQUEST | TARGET RESPONSE |
|------------------------|----------------|-------------------|
| ID/Authentication | x (optional) | |
| Options | x | x |
| Preferred-Message-Size | x | x |
| Maximum-Record-Size | x | x |
| Result | | x |
| User-Information-Field | x (optional) | x (optional) |
| Reference-ID | x (optional) | x (if applicable) |

In addition
Init response

If the request
"will use" for
subject to

In addition, the Init request specifies either "will support" or "will not support," and the Init response specifies "will use" or "will not use" for each of the following capabilities:

1. resource-control
2. access-control.

If the request specifies "will not support" for a given capability, and the response specifies "will use" for that capability, then the value of Result must be "reject." These capabilities are subject to expansion in future versions of this protocol and are defined as follows:

Search—The origin specifies "will use" for "search" if it intends to submit Search requests. If so, the target indicates that it is willing (or unwilling) to accept Search requests by specifying "will support" (or "will not support") for "search."

Present—The origin specifies "will use" for "present" if it intends to submit Present requests. If so, the target indicates that it is willing (or unwilling) to accept Present requests by specifying "will support" (or "will not support") for "present."

Delete—The origin specifies "will use" for "delete" if it intends to submit Delete requests. If so, the target indicates that it is willing (or unwilling) to accept Delete requests by specifying "will support" (or "will not support") for "delete."

Resource-Control—The origin indicates that it is prepared to receive and respond to a Resource-Control request from the target, by specifying "will support" for "resource-control." Conversely, the origin indicates that it is not prepared to receive a Resource-Control request by specifying "will not support." In the latter case, if the target cannot suppress sending a Resource-Control request, it should reject the connection by setting Result to "reject," specifying "will use" for "resource-control," and (optionally) supplying a text message in the User-Information-Field.

Access-Control—Likewise, the origin indicates whether or not it is prepared to receive and respond to an Access-Control request from the target, by specifying "will support" or "will not support" for "access-control."

Security is invoked at different levels. In addition to user authentication at the outset of an association, security might be invoked to control access to a particular database, record, result-set, or use of a command.

If the origin is not capable of receiving an Access-Control request, and if security requirements on the target system mandate that security (other than that which might be provided by the parameter ID/Authentication) be invoked at the outset of an association, then the target should reject the association by setting the parameter Result to "reject," and specifying "will use" for "access-control." However, if the target invokes security, but not at the association level, then the target may choose to accept the connection. In that case, if the target subsequently receives a command

that would trigger an Access-Control request, the target agrees to suppress the request and respond to the command with an error status indicating that a security challenge was required but could not be issued.

3.2.1.1.3 Preferred-Message-Size and Maximum-Record-Size. The Init request contains Preferred-Message-Size and Maximum-Record-Size, specified in bytes. Maximum-Record-Size must be greater than or equal to Preferred-Message-Size. The Init response contains both the Preferred-Message-Size and Maximum-Record-Size that the target is going to use.

The target has the option of responding with values different from those requested by the origin (however, Preferred-Message-Size must be less than or equal to Maximum-Record-Size), in which case, the origin may abort the connection if those values are not acceptable.

The usage of these parameters is specified in section 3.3.

3.2.1.1.4 Result. The target indicates whether or not it accepts the association by specifying a value of "accept" or "reject" respectively in the parameter Result. If "reject" is indicated, the origin is expected to terminate communication.

3.2.1.1.5 User-Information-Field. This field may be used by either the origin or target for additional information, not specified by this standard.

3.2.1.1.6 Reference-ID. See section 3.4.

3.2.2 Search Facility. The Search facility enables an origin system to query databases at a target system, and to receive information about the results of the query.

3.2.2.1 Search Service Element. The Search service element allows an origin to send a query to a target. The query takes the following basic form: from the specified set of items, identify those with the properties indicated. The set of items identified is called the "result set," and is maintained by the target for subsequent retrieval requests. However, depending on the parameters of the search, one or more items identified by the result set may be immediately returned as part of the search response. The result set is an ordered set; items identified by entries in the result set are referenced by the position of the entry within the result set, beginning with one (1). (See Table 2.)

3.2.2.1.1 Query-Type, Query, and Database-Names. The parameter Query-Type identifies the syntax of the query. As noted above, the basic query concept is "from the specified set of items, identify those with the properties indicated." The "specified set of items" is a collection of one or more databases, specified by the parameter Database-Names. The "properties indicated" are specified by the parameter Query.

The target designates, by agreement outside the scope of the standard, what databases may be specified on a Search request, and also in what combinations they may be specified. For example, a target might specify that databases A, B, and C may be searched individually, and that A and B may be searched in combination (but not A and C, nor B and C). If an origin requests a combination of databases which is not supported, the search will result in a diagnostic, such as "combination of specified databases not supported" (see appendix D).

3.2.2.1.2 Result-Set-Name and Replace-Indicator. The parameter Result-Set-Name specifies a name to be given to the result set which will be created by the query so that it may be subsequently referenced within the same association. If a result set with the same name

already exists
Replace-Indicator

If a result set
then a result set
ignored. The
A target system
for conforming
name is "Result-Set-Name"
Result-Set-Name
A result set
Name) may be
Search request
available for
which it is

Table 2
Parameters of the Search Service Element

| PARAMETER | ORIGIN REQUEST | TARGET RESPONSE |
|-----------------------------|-------------------|--------------------|
| Query-Type | x | |
| Query | x | |
| Database-Names | x | |
| Result-Set-Name | x | |
| Replace-Indicator | x | |
| Element-Set-Names | x (optional) | |
| Small-Set-Upper-Bound | x | |
| Large-Set-Lower-Bound | x | |
| Medium-Set-Present-Number | x | |
| Database/Diagnostic-Records | | x (if applicable) |
| Result-Count | | x |
| Number-of-Records-Returned | | x |
| Next-Result-Set-Position | | x |
| Search-Status | | x |
| Result-Set-Status | | x (if applicable) |
| Present-Status | | x (if applicable) |
| Reference-ID | x (optional) | x (if applicable) |

already exists at the target, then the action taken depends on the value of the parameter Replace-Indicator, as follows:

- If the value of Replace-Indicator is "on," then prior to processing the query, the existing result set whose name is specified by the parameter Result-Set-Name will be deleted, and a new result set by that name created. The initial content of the result set is null.
- If the value of Replace-Indicator is "off," the search is not processed; an error diagnostic is returned by the target and the existing result set whose name is specified by the parameter Result-Set-Name is left unchanged.

If a result set does not exist with the name specified by the parameter Result-Set-Name, then a result set by that name is created by the target and the parameter Replace-Indicator is ignored. The initial content of the result set is null.

A target system need not support, in general, the naming of result sets by the origin (see for conformance section 4.4.3, "Statement Requirements"). However, the result set whose name is "default" must be supported by the target system. If the origin specifies "default" as Result-Set-Name, then the Replace-Indicator must be "on."

A result set created by a Search request (that is, specified by the parameter Result-Set-Name) may be referenced in a subsequent Present request or as an operand in a subsequent Search request (for example, in a Type-1 query). The result set named "default" remains available for reference from the time it is created until the end of the association during which it is created, or until it is either:

- overwritten, because the name "default" is specified as Result-Set-Name in a subsequent Search request, or

- unilaterally erased or deleted by the target.

Any result set other than the result set named “default” remains available for reference from the time it is created until it is deleted in one of the following ways:

- by a Delete request
- implicitly, because a result set was specified by the same name in a Search request, and the value of the parameter Replace-Indicator was "on"
- unilaterally by the target (at any time)
- by termination of the association.

3.2.2.1.3 Element-Set-Names. An element set name is a primitive name that specifies a particular subset of the elements in a database record that are to compose the response records. Element set names are specified, along with their definitions, for a given database, by the target, outside of this standard. The target specified a default element set for each database.

The parameter Element-Set-Names is a set of one or more pairs of a database name and associated element set name. For each database record returned in a Search (or Present) response, if the given database is specified (as a component of one of the pairs comprising Element-Set-Names), then the response record should be composed according to the corresponding element set name. If not, the response-record should be composed according to the default element set name for that database.

The parameter Element-Set-Names may alternatively consist of a single element set name (from those defined by the target system), with no database specified. In that case, for each database record returned in a Search (or Present) response:

- if the specified element set name is valid for the given database, the response-record should be composed according to that element set name;
- if the specified element set name is *not* valid for the given database, the response-record should be composed according to the default element set name for that database.

3.2.2.1.4 Small-Set-Upper-Bound, Large-Set-Lower-Bound, and Medium-Set-Present-Number (See 3.2.2.1.6). The number of database records identified by the result set is referred to as the result-count. The result set is considered either a "small set," a "medium set," or a "large set," depending on Result-Count and the parameters of the search. The result set is a small set if Result-Count is not greater than Small-Set-Upper-Bound. The result set is a large set if Result-Count is larger than or equal to Large-Set-Lower-bound. Otherwise, the result set is a medium set.

If the query results in a small set, all database records identified by the result set are to be returned to the origin (subject to possible message size constraints). If the query results in a large set, no database records are to be returned. If the query results in a medium set, the number of database records to be returned is specified by Medium-Set-Present-Number (which does not exceed Small-Set-Upper-Bound).

The use of these three parameters is illustrated by the following example. Assume that the values 10 to 100 respectively are specified for Small-Set-Upper-Bound and Large-Set-

Lower-Budgeted films are to be returned. All films turned in for the requested rights but if the film is not returned, the Present-Budgeted films

3.3.2.15
result set that is
processing, must
not be returned to
transfer sublayer.

After: previous
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and Result of
turned, a diagram
is one of the

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- * a bun
becau
- * a sing
com
- * a sing
adit

The order of parameter Data is defined by the results of the database in which the first record being different than its first

Count is the number of rows in the table.
Count is zero. The table is empty.
(database and table name)

ifies the position
the last record in

3.2.2.1.4 and assumes that

- Size
- Cost

A value of

Lower-Bound. If the search results in ten or fewer database records, then all database records are to be returned. If the search results in 100 or more database records then none is to be returned. **Medium-Set-Present-number** specifies how many database records are to be returned in the event that the number of database records identified is between 11 and 99. The requester might wish to specify "if there are ten fewer less database records, send them all, but if there are more than 10 (but less than 100) send only two." In this case, **Medium-Set-Present-Number** is specified as 2.

3.2.2.1.5 Database/Diagnostic-Records. The target processes the search, creating a result set that identifies a set of database records. It cannot be assumed, however, that search processing requires physical access to the database records; thus one or more records might not be returnable, but this circumstance might not be recognized until an attempt is made to transfer such a record.

After processing the search, the target attempts to retrieve the first N records identified by the result set, to be included in the Search response (N depends on the search parameters and **Result-Count**, as described in section 3.2.2.1.4). For each record that cannot be returned, a diagnostic record is substituted. Thus the parameter **Database/Diagnostic-Records** is one of the following:

- N database and/or diagnostic records,
- a number of database and/or diagnostic records, which is less than N because of message size constraints (see section 3.3),
- a single diagnostic record indicating that the search cannot be processed, and why it cannot be processed, or
- a single diagnostic record indicating that records cannot be presented, and why not.

The order of occurrence of records (database and/or surrogate diagnostic) within the parameter **Database/Diagnostic-Records** is according to the order in which they are identified by the result set. Each database record may optionally be accompanied by the name of the database in which the record resides. However, the database name must accompany the first record being returned, and must accompany any record coming from a database different than its immediate predecessor.

3.2.2.1.6 Result-Count and Number-of-Records-Returned. The parameter **Result-Count** is the number of records identified by the result set. If the result set is empty, **Result-Count** is zero. The parameter **Number-of-Records-Returned** is the total number of records (database and diagnostic) returned in the Search response.

3.2.2.1.7 Next-Result-Set-Position. The parameter **Next-Result-Set-Position** specifies the position within the result set of the next record following those returned (or zero if the last record in the result set is being returned).

3.2.2.1.8 Search-Status. The parameter **Search-Status** is returned in the response and assumes one of the following two values:

- success—the search completed successfully
- failure—the search did not complete successfully.

A value of "success" does not imply that the expected database and/or surrogate diag-

nostic records are being returned as part of the response (see Present-Status, section 3.2.2.1.9). A value of "failure" *does* imply that *none* of the expected database and/or surrogate diagnostic records is being returned. In the latter case, the target returns a single diagnostic record indicating that the search cannot be processed.

3.2.2.1.9 Result-Set-Status and Present-Status. These are status descriptors necessary to dissambiguate certain situations that can occur during search and present operations.

Result-Set-Status occurs if and only if the value of Search-Status is "failure," and its value is one of the following:

- subset — Partial, valid results available
- interim — Partial results available, not necessarily valid
- none — No results available.

Present-Status occurs if and only if the value of Search-Status is "success," and its value is one of the following:

- success — All of the expected database (or surrogate diagnostic) records are available.
- partial-1 — Not all of the expected records can be returned because the request was terminated by access-control.
- partial-2 — Not all of the expected records can be returned because the request was terminated by maximum message size.
- partial-3 — Not all of the expected records can be returned because the request was terminated by resource-control at origin.
- partial-4 — Not all of the expected records can be returned because the request was terminated by resource-control at target.
- failure — None of the expected database (or surrogate diagnostic) records can be returned. A single diagnostic is returned, which is not a surrogate for a database record.

3.2.2.1.10 Reference-ID. See section 3.4.

3.2.3 Retrieval Facility. The Retrieval facility enables the origin to retrieve a copy of records according to position within a result set maintained by the target.

3.2.3.1 Present Service Element. The Present Service element allows the origin system to retrieve records from a specified result set. Records are referenced by relative position within the result set. The origin specifies a range of records to be retrieved and may follow with subsequent requests specifying different ranges. For example, the origin may retrieve records one through five and follow with a request for records four through six. (See Table 3.)

3.2.3.1.1 Number-of-Records-Returned and Result-Set-Start-Position. The origin requests the return of N records beginning at record M , from the result set, where $N = \text{Number-of-Records-Requested}$ and $M = \text{Result-Set-Start-Position}$ (and N is not greater than $\text{Result-Count} = M + 1$).

3.2.3.1.2 Result-Set-ID. Result-Set-ID specifies the result set from which records are

Number of
Result-Set
Element
Database
Next-Record
Present-Status
Reference-ID

to be retrieved. If the
the parameter Result-Set-ID

3.2.3.1.3

3.2.3.1.4

ords returned by

Number of
Result-Set
Element
(Result-Set-ID)
Next-Record
Present-Status

The order of
parameter Database
fied by the result-
the database in the
first record being
ferent than its last

3.2.3.1.5

eter Number-of-Records-Returned. Next-Record-Position following the last record in the database or surrogate

3.2.3.1.6

values are the

3.2.3.1.7

3.2.4

tem to insure that the system response

Table 3
Parameters of the Present Service Element

| PARAMETERS | ORIGIN REQUEST | TARGET RESPONSE |
|-----------------------------|-------------------|--------------------|
| Number-of-Records-Requested | x | |
| Result-Set-Start-Position | x | |
| Result-Set-ID | x | |
| Element-Set-Names | x (optional) | |
| Database/Diagnostic-Records | | x (if applicable) |
| Number-of-Records-Returned | | x |
| Next-Result-Set-Position | | x |
| Present-Status | | x |
| Reference-ID | x (optional) | x (if applicable) |

to be retrieved. It is the result set created by a previous Search request for which the value of the parameter Result-Set-Name matches the value of Result-Set-ID.

3.2.3.1.3 Element-Set-Names. See section 3.2.2.1.3.

3.2.3.1.4 Database/Diagnostic-Records. The parameter Database/Diagnostic-Records returned by the target consists of one of the following:

- N database and/or diagnostic records, where $N = \text{Number-of-Records-Requested}$,
- a number of database and/or diagnostic records, which is less than N (reason specified by Present-Status), or
- a single diagnostic record indicating that the request cannot be processed, and why it cannot be processed.

The order of occurrence of records (database and/or surrogate diagnostic) within the parameter Database/Diagnostic-Records is according to the order in which they are identified by the result set. Each database record may optionally be accompanied by the name of the database in which the record resides. However, the database name must accompany the first record being returned, and must accompany any record coming from a database different than its immediate predecessor.

3.2.3.1.5 Number-of-Records-Returned and Next-Result-Set-Position. The parameter Number-of-Records-Returned is the total number of database and diagnostic records returned. Next-Result-Set-Position is the position within the result set of the next record following the last database or surrogate diagnostic record being returned (or zero, if the last database or surrogate diagnostic record in the result set is being returned).

3.2.3.1.6 Present-Status. Present-Status is mandatory in a Present response and its values are the same as those listed for Present-Status in section 3.2.2.1.9.

3.2.3.1.7 Reference-ID. See section 3.4.

3.2.4 Result-Set-Delete Facility. The Result-Set-Delete facility enables an origin system to instruct a target system to delete a result set known to the target system. The target system responds with a confirmation message or an error report.

3.2.4.1 Delete Service Element. The Delete Service element enables an origin system to send a Delete request to the target. The origin system may request deletion of a specific result set held by the target system, or all result sets currently on the target system created during this association. The target responds by reporting the status of the requested delete operation.

Table 4
Parameters of the Delete Service Element

| PARAMETERS | ORIGIN REQUEST | TARGET RESPONSE |
|--------------------|-------------------|-------------------|
| Delete-Operation | x | x (if applicable) |
| Result-Set-ID | x (if applicable) | x |
| Delete-Status | | x (if applicable) |
| Number-Not-Deleted | | x (if applicable) |
| Bulk-Statuses | | x (optional) |
| Delete-MSG | x (optional) | x (if applicable) |
| Reference-ID | | |

3.2.4.1.1 Delete-Operation. The origin specifies one of the following:

- single — delete a specific result set (see section 3.2.4.1.2), or
- all — delete all result sets currently on the target system created during this association.

3.2.4.1.2 Result-Set-ID. If Delete-operation is "single," then the origin specifies a result set to be deleted, which was created by a previous Search request for which the value of the parameter Result-Set-Name matches the value of the parameter Result-Set-ID. The target echoes the name of the deleted result set in the response.

3.2.4.1.3 Delete-Status. Delete-status is used by the target to report the status of the delete request. If Delete-Operation is "single," Delete-Status has the following possible values:

- success — Result set(s) deleted.
- failure-1 — Result set did not exist.
- failure-2 — Result set previously unilaterally deleted by target.
- failure-3 — System problem at target. (optional text message may be included in the Delete-MSG parameter).
- failure-4 — Access control failure: the delete request caused the target system to issue an Access-Control request that the origin system failed to satisfy, or the origin could not accept an Access-Control request.
- failure-5 — Request terminated by origin system through resource control.
- failure-6 — Access terminated by target system due to resource constraints.

If Delete-Operation

parameter Result-Set-ID

3.2.4.1.1
parameter Result-Set-ID

Note, however, that if not deleted on the first failure, the status might be

If the first failure message, the target

3.2.4.1.2

3.2.4.1.3

3.2.5 Access-Control

challenge an origin

An origin

Control request

target system

tion did not

Search request

with an Access

before receiving

Once the

taken place

Present, or

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respond

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tion-Field

The Access

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tent of the

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3.2.5.1

If Delete-operation is "all," the following status responses are also possible:

- failure-7 — Bulk delete of result sets not supported by target.
- failure-8 — Not all results sets deleted (see 3.2.4.1.4).

3.2.4.1.4 Number-Not-Deleted and Bulk-Statuses. If Delete-Status = "failure-8," the parameter Number-Not-Deleted indicates how many result sets were not deleted, and the parameter Bulk-Statuses gives individual statuses for those not deleted.

Note, however, that a target system is not obligated to provide statuses for each result set not deleted on a bulk delete. For example, a target system may abort a bulk delete when the first failure to delete a result set that is part of the bulk delete fails; in this case only a single status might be included in the parameter Bulk-Statuses.

If the bulk delete results in more statuses than can fit into a single Delete response message, the target system may discard those which do not fit.

3.2.4.1.5 Delete-MSG. Delete-MSG, if present, contains an optional text message.

3.2.4.1.6 Reference-ID. See section 3.4.

3.2.5 Access Control Facility. The access control facility allows a target system to challenge an origin system during execution of an Init, Search, Present, or Delete operation.

An origin system must be prepared to accept and respond to one or more Access-Control requests while an Init, Search, Present, or Delete request is being executed by the target system (unless the parameter Options of the Init request which initiated the connection did not include access control; see section 3.2.1.1.2). For example, after sending a Search request, the origin must be prepared to receive an Access-Control request, respond with an Access-Control response, then later receive another Access-Control request, etc., before receiving a Search response.

Once the origin has responded, the operation proceeds as if the challenge has never taken place. If the origin system fails to respond correctly to the challenge during a Search, Present, or Delete request, then the Search, Present, or Delete response will indicate that the operation was terminated due to an access control failure. If the origin system fails to respond correctly to the challenge during an Init request, the target will set the Result parameter to "reject" and may (optionally) supply such an indication in the User-Information-Field of the Init response.

The Access-Control request/response mechanism can be used to support password challenges, public key cryptosystems, or algorithmic authentication, etc. The specific content of the Access-Control request and response parameters are outside the scope of this standard.

3.2.5.1 Access-Control Service Element

Table 5
Parameters of Access-Control Service Element

| PARAMETERS | TARGET REQUEST | ORIGIN RESPONSE |
|-----------------------------|-------------------|--------------------|
| Security-Challenge | x | |
| Security-Challenge-Response | | x |
| Reference-ID | x (if applicable) | x (if applicable) |

3.2.5.1.1 Security-Challenge and Security-Challenge-Response. The content of these two parameters are outside the scope of this standard and must be established by prior agreement between a given target/origin system pair.

3.2.5.1.2 Reference-ID. See section 3.4.

3.2.6 Accounting/Resource Control Facility. The Accounting/Resource Control facility permits the target system to notify the origin system when either actual or predicted resource consumption will exceed agreed upon limits (or limits built into the target system), and to obtain the origin system's consent to continue. In addition, the target system can inform the origin system about the current status of a result set being generated on the target in response to a Search request, and indicate information about the status of the current request.

3.2.6.1 Resource-Control Service Element

A target system may issue a Resource-Control request in response to an Init, Search, Delete, or Present request. The origin system must respond to the Resource-Control request, after which processing continues (from the point of view of message sequencing) as if the request/response sequence never occurred. An origin should be prepared to respond to multiple Resource-Control requests during the execution of an Init, Search, Delete or Present request.

If the origin responds to a Resource-Control request with a Resource-Control response saying to terminate the command, it can expect to receive an Init, Search, Present, or Delete response. This response might indicate that the Init, Search, Present, or Delete operation was terminated by request of the origin. However, the response might alternately indicate that the request completed, since the operation at the target system may continue to execute and subsequently complete before the Resource-Control response reaches the target system. (See Table 6.)

3.2.6.1.1 Resource-Report. Resource-report may be used to convey information about the current and estimated resource consumption at the target system. The format of Resource-Report is not defined in the standard. Appendix E contains an example.

3.2.6.1.2 Partial-Results-Available. The target indicates the status of the result set via the flag Partial-Result-Available, whose value is one of the following:

- subset — partial, valid results available
- interim — partial results available, not necessarily valid
- none — no results available.

Table 6
Parameters of the Resource-Control Service Element

| PARAMETERS | TARGET REQUEST | ORIGIN RESPONSE |
|---------------------------|-------------------|-------------------|
| Resource-Report | x (optional) | |
| Suspended-Flag | x | |
| Partial-Results-Available | x (if applicable) | |
| Continue-Flag | | x |
| Result-Set-Wanted | | x (if applicable) |
| Reference-ID | x (if applicable) | x (if applicable) |

This part of the
"interim,"
terminated
Wanted is

If the origin
subsequent
Control response

Note that
since processing
Set-Status in

3.2.6.1.1
the command

3.2.6.1.2
processing

3.2.6.1.3

If the origin
subsequent
set. A result
has discarded
the Search
which the

3.2.6.1.4

3.2.7

Both
RELEASE

3.2.7.1
send of

3.2.7.2
following
of an
might
applic

This parameter is meaningful only during a search operation. If its value is "subset" or "interim," then the target will accept subsequent Present requests if the current request is terminated by the Resource-Control response and if the value of the parameter Result-Set-Wanted is "on."

If the value of Partial-Results-Available is "none" then the target need not accept subsequent Present requests in the event that the request is terminated by the Resource-Control response.

Note that if Suspended-Flag is off, the partial results available situation may change since processing continues on the search. In all cases, the values of Search-Status and Result-Set-Status in the Search response should be treated as the authoritative information.

3.2.6.1.3 Suspended-Flag. The target system indicates whether or not processing of the command has been suspended pending the Resource-Control response.

3.2.6.1.4 Continue-Flag. The origin indicates to the target whether or not to continue processing.

3.2.6.1.5 Result-Set-Wanted. This flag is meaningful only:

- during a Search request,
- when the value of Partial-Results-Available is "subset" or "interim," and
- when the value of the parameter Continue-Flag is "do not continue."

If the value of the flag is "on," the target will maintain the (possibly partial) result set for subsequent Present requests. If the value of the flag is "off," the target may delete the result set. A result set status of "none" on the subsequent Search response indicates that the target has discarded the result set. In all cases, the values of Search-Status and Result-Set-Status in the Search response describe the actual decisions made by the target system and the way in which the search terminated.

3.2.6.1.6 Reference-ID. See section 3.4.

3.2.7 Termination Facility. The Termination facility allows either:

- (1) an origin or target to initiate abrupt termination of the association via the IR-Abort service element, or
- (2) an origin system to initiate graceful termination via the IR-Release service element.

Both the IR-Abort and IR-Release services map directly onto the A-ABORT and A-RELEASE services of the common application association control services.

3.2.7.1 IR-Abort Service Element. Either the origin or target may at any time either send or receive an IR-Abort request, and consider the application association terminated.

3.2.7.2 IR-Release Service Element. The origin may invoke an IR-Release request following receipt of an Init, Search, Present, or Delete response. It should then await receipt of an IR-Release response, and then consider the association terminated. Alternately, it might receive an IR-Abort request from the target, in which case it should consider the application association terminated.

The target may receive an IR-Release request after sending an Init, Search, Present, or Delete response, or a Resource-Control or Access-Control request. It should then send an IR-Release response, and consider the association terminated.

3.3 Message Size Limitations. For both the Search and Present service elements, it is possible that the target will not be able to return the number of database records requested because of message size limitations. In that case, the target is responsible for packing as many records as possible into the response message. (Note: A response message always contains an integral number of records; a record never spans response messages.)

Illustration. Assume that the target is attempting to transmit records in result set positions 1 through 10 (in this section, the term "record" means "database or surrogate diagnostic record," unless "diagnostic record" or "database record" is specified). Assume further that:

- records in position 1 through 6 fit in the response message, such that the sum of the sizes of the records (not including any protocol control information) does not exceed Preferred-Message-Size; but,
- the database record in position 7 will not fit in the message along with records in position 1 through 6 without the resulting sum of the message sizes exceeding Preferred-Message-Size.

The size of the database record in position 7:

- (a) does not exceed Preferred-Message-Size, or
- (b) exceeds Preferred-Message-Size, but does not exceed Maximum-Record-Size, or
- (c) exceeds Maximum-Record-Size.

In case (a), the target returns records in position 1 through 6.

In case (b), except as noted below (see "Exception"), the target substitutes a diagnostic record for the database record in position 7, indicating that the record exceeds Preferred-Message-Size. In case (c) the target substitutes a diagnostic record for the database record in position 7, indicating that the record exceeds Maximum-Record-Size. (If Maximum-Record-size equals Preferred-Message-Size then there is no distinction between the meaning of the two diagnostics.)

In case (b) or (c) if the diagnostic record will not fit along with the records in position 1 through 6, the target returns the records in position 1 through 6. (Preferred-Message-Size must always be large enough to contain any diagnostic record; thus a subsequent Present request beginning with the record in position 7 will retrieve the diagnostic.) Otherwise, the target inserts the diagnostic record and proceeds to attempt to fit records in positions 8 through 10 into the response message.

Exception. If a Present request specifies a single record (i.e., Number-of-Records-Requested equals 1) then if the size of that record exceeds Preferred-Message-Size, but does not exceed Maximum-Record-Size, the target will return that single database record in the Present response. Note that this exception applies only to a Present request and not to a Search request.

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Note that
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3.4 Reference
Delete request

If Reference-IDs
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intermediate
The service
Search, Present
Present or Delete
The purpose
Reference-IDs
system.

4. Protocol

This section
The following
governing the
unit of information
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4.1 Abstract
protocol data unit
by the first
data element
(section 4.1.1)

4.1.1 App
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others.

The
datatype
"Type"

Thus in case (b), the origin may subsequently request the database record in position 7, by issuing a Present request in which that record is the only record requested.

Note that the purpose of this distinction between Preferred-Message-Size and Maximum-Record-Size is to allow the transfer of normal length records to proceed in a routine fashion, with convenient buffer sizes, but also to provide for the transfer of an occasional exceptionally large database record without requiring the origin to continually allocate and hold local buffer space for worst-case records. Note also that this intended purpose is defeated if the origin routinely requests a single record.

3.4 Reference-ID. The parameter Reference-ID is optional in an Init, Search, Present, and Delete request. If supplied, it may assume any value (subject to length restriction), and

- it must be echoed by the target in the respective response;
- it must be echoed in both the request and response of any intermediate Access-Control or Resource-Control request/response sequences.

If Reference-ID is not supplied in an Init, Search, Present, or Delete request, then it is not to appear in the respective response, nor in either the request or response of any intermediate Access-Control or Resource-Control request/response sequence.

The service does not assume any relationship between the Reference-ID used in an Init, Search, Present, or Delete request and the Reference-ID used in any other Init, Search, Present, or Delete request.

The purpose of this parameter is to facilitate the grouping of events by the origin system. Reference-IDs are always assigned by the origin and have meaning only within the origin system.

4. Protocol Specification

This version of the Information Retrieval protocol is version 1.

The Information Retrieval application protocol specifies the formats and procedures governing the transfer of information between peer information retrieval applications. A unit of information passed between two peer applications is called an "application protocol data unit" or APDU.

4.1 Abstract Syntax of the Information Retrieval Protocol. The Information Retrieval protocol data units are complex data types. The transfer syntax of these data types is negotiated by the presentation service provider. The definitions in this section specify the component data elements of the protocol data units (section 4.1.1), and the Type-0 and Type-1 queries (section 4.1.2).

4.1.1 Application Protocol Data Units (APDUs). In the following data-element definitions, column R/O/C specifies that the element is required (R), optional (O), or conditionally required (C), that is, it is required in some circumstances and not required in others.

The term "ANY" refers to a string of N arbitrary bits, where N is a multiple of 8; no datatype is implied.

"Text" refers to a character string composed from the ASCII repertoire of control and

graphic characters (i.e., the repertoire from X3.4). Only the character repertoire, and not the encoding is implied.

"Identifier" refers to a character string of up to 64 characters composed from the repertoire represented by the character positions 2/1 through 7/14 of X3.4. Within an identifier, the upper and lower case of a given letter are considered to be the same character.

"Integer" refers to an unsigned integer whose value is between zero and 16,777,215.

Numeric values are considered to be integers unless enclosed in quotes.

4.1.1.1 Init APDU

Table 7
Abstract Syntax of the Init APDU

| Element | R/O/C | Value/Usage |
|------------------------|-------|---|
| PDU-Type | R | 20—Init |
| Protocol-Version | R | see note below |
| Options | R | a string of boolean values. 0 = "will not use" and 1 = "will use" for each of: search present delete 0 = "will not support" and 1 = "will support" for each of: access-control resource-control |
| Preferred-Message-Size | R | integer |
| Maximum-Record-Size | R | integer; must equal or exceed Preferred-Message-Size if present |
| ID/Authentication | O | ANY; maximum 64 bytes |
| Implementation-ID | O | identifier; a unique identifier for the origin implementation |
| Implementation-Name | O | identifier; a descriptive name for the origin implementation |
| Implementation-Version | O | identifier; a descriptive name for the origin implementation version |
| Reference-ID | O | ANY; maximum 64 bytes |
| User-Information-Field | O | ANY |

Note: The protocol version consists of a string of boolean values, each value representing a version. The first value set to 1 indicates version 1 is available, the second value set to 1 indicates version 2 is available, and so on. Values higher than the highest known version should be ignored. Both the Init request and Init response include a value string corresponding to the supported versions. The highest common version is selected for use. If there are no versions in common, the Init-Response should indicate a value of "reject" for the parameter Result.

Element

PDU-Type

Result

Protocol-Version

Options

Preferred-Message-Size

Maximum-Record-Size

Implementation-ID

Implementation-Name

Implementation-Version

Reference-ID

User-Information-Field

4.1.1.2 Init-Response APDU

Table 8
Abstract Syntax of the Init-Response APDU

| Element | R/O/C | Value/Usage |
|------------------------|-------|---|
| PDU-Type | R | 21 = Init-Response |
| Result | R | 1 = "accept", 0 = "reject" |
| Protocol-Version | R | see note in 4.1.1.1 |
| Options | R | a string of boolean values. 0—"will not support" and 1—"will support" for each of: search present delete 0—"will not use" 1—"will use" for each of: access-control resource-control |
| Preferred-Message-Size | R | integer |
| Maximum-Record-Size | R | integer; must equal or exceed Preferred-Message-Size |
| Implementation-ID | O | identifier; a unique identifier for the target implementation |
| Implementation-Name | O | identifier; a descriptive name for the target implementation |
| Implementation-Version | O | identifier; a descriptive name for the target implementation version |
| Reference-ID | C | ANY; identical to Reference-ID in the Init APDU |
| User-Information-Field | O | ANY |

4.1.1.3 Search APDU

Table 9
Abstract Syntax of the Search APDU

| Element | R/O/C | Value/Usage |
|---------------------------|-------|---|
| PDU-Type | R | 22 = Search |
| Small-Set-Upper-Bound | R | integer |
| Large-Set-Lower-Bound | R | integer; greater than small-set-upper-bound unless both are zero |
| Medium-Set-Present-Number | R | integer; less than or equal to small-set-upper-bound |
| Replace-Indicator | R | 0 = "off"; 1 = "on". Must be "on" if Result-Set-Name = "default" |
| Result-Set-Name | R | identifier |
| Database-Names | R | one or more identifiers |
| Query-Type | R | 0 = Type-0, 1 = Type-1. Other types are for future study and standardization. |
| Element-Set-Names | O | a single element set name, or one or more pairs of (database name, element set name); each element set name and each database name is an identifier |
| Reference-ID | O | ANY; maximum 64 bytes |
| Query | R | structure; structures for query-types Type-0 and Type-1 are specified in section 4.1.2. |

Element

PDU-Type
Number of Records
Result-Set-Name
Result-Set-Position
Element-Set-Names
Reference-ID

4.1.1.4 Search

Element

PDU-Type
Present-Status
Number of Records
Next-Result-Set-Position
Reference-ID

Database/Diagnostic

4.1.1.4 Search-Response APDU

Table 10
Abstract Syntax of the Search-Response APDU

| Element | R/O/C | Value/Usage |
|-----------------------------|-------|---|
| PDU-Type | R | 23 = Search-Response |
| Search-Status | R | 0 = "success", 1 = "failure" |
| Result-Count | R | integer |
| Number-of-Records-Returned | R | integer |
| Next-Result-Set-Position | R | integer |
| Result-Set-Status | C | 1 = "subset", 2 = "interim", 3 = "none" |
| Present-Status | C | 0 = "success", 1 = "partial-1", 2 = "partial-2", 3 = "partial-3", 4 = "partial-4", 5 = "none" |
| Reference-ID | C | ANY; identical to Reference-ID in the Search APDU |
| Database/Diagnostic-Records | C | see section 3.2.2.1.5. |

Element

PDU-Type
Delete-Count
Result-Set-Position

Reference-ID

4.1.1.5 Present APDU

Table 11
Abstract Syntax of the Present APDU

| Element | R/O/C | Value/Usage |
|-----------------------------|-------|-----------------------|
| PDU-Type | R | 24 = Present |
| Number-of-Records-Requested | R | integer |
| Result-Set-Start-Position | R | integer |
| Result-Set-ID | R | identifier |
| Element-Set-Names | O | see section 4.1.1.3 |
| Reference-ID | O | ANY; maximum 64 bytes |

4.1.1.6 Present-Response APDU

Table 12
Abstract Syntax of the Present-Response APDU

| Element | R/O/C | Value/Usage |
|-----------------------------|-------|--|
| PDU-Type | R | 25 = Present-Response |
| Present-Status | R | see section 4.1.1.4 |
| Number-of-Records-Returned | R | integer |
| Next-Result-Set-Position | R | integer |
| Reference-ID | C | ANY; identical to Reference-ID in the Present APDU |
| Database/Diagnostic-Records | C | see section 3.2.3.1.4 |

4.1.1.7 Delete APDU

Table 13
Abstract Syntax of the Delete APDU

| Element | R/O/C | Value/Usage |
|------------------|-------|---|
| PDU-Type | R | 26 = Delete |
| Delete-Operation | R | 1 = "single", 2 = "all" |
| Result-Set-ID | C | identifier; present if and only if Delete-Operation = 1 |
| Reference-ID | O | ANY; maximum 64 bytes |

4.1.1.8 Delete-Response APDU

Table 14
Abstract Syntax of the Delete-Response APDU

| Element | R/O/C | Value/Usage |
|--------------------|-------|---|
| PDU-Type | R | 27 = Delete-Response |
| Delete-Status | R | 0 = "success", 1 = "failure-1", 2 = "failure-2", 3 = "failure-3", 4 = "failure-4", 5 = "failure-5", 6 = "failure-6", 7 = "failure-7", 8 = "failure-8" |
| Result-Set-ID | C | identifier; identical to Result-Set-ID in Delete APDU, and present if and only if Delete-Operation was 1 |
| Number-Not-Deleted | C | integer; present if and only if Delete-Status = 8 |
| Bulk-Statuses | C | one or more pairs of (identifier, integer), see section 3.2.4.1.4; present if and only if Delete-Status = 8 |
| Delete-MSG | O | contains a text message |
| Reference-ID | C | ANY; identical to Reference-ID in the Delete APDU |

4.1.1.9 Access-Control APDU

Table 15
Abstract Syntax of the Access-Control APDU

| Element | R/O/C | Value/Usage |
|--------------------|-------|--|
| PDU-Type | R | 28 = Access-Control |
| Security-Challenge | R | ANY; value and usage not specified by this standard |
| Reference-ID | C | ANY; identical to Reference-ID in the Init, Search, Present, or Delete APDU that initiated the current operation |

4.1.1.10 Access-Control-Response APDU

Table 16
Abstract Syntax of the Access-Control-Response APDU

| Element | R/O/C | Value/Usage |
|-----------------------------|-------|--|
| PDU-Type | R | 29 = Access-Control-Response |
| Security-Challenge-Response | R | ANY; value and usage not specified by this standard |
| Reference-ID | C | ANY; identical to Reference-ID in the Access-Control APDU |

Element

PDU-Type
SuspendedResource-Set
Partial-Reference-Set

Element

PDU-Type
Continue-Flag
Result-Set-Value

Reference-ID

4.1.2 Abstr.

4.1.2.1

The Type

4.1.1.11 Resource-control APDU

Table 17
Abstract Syntax of the Resource-Control APDU

| Element | R/O/C | Value/Usage |
|---------------------------|-------|--|
| PDU-Type | R | 30 = Resource-Control |
| Suspended-Flag | R | 1 = "operation suspended", 2 = "operation not suspended" |
| Resource-Report | O | contains a text message |
| Partial-Results-Available | C | 1 = "subset", 2 = "interim", 3 = "none" |
| Reference-ID | C | ANY; identical to Reference-ID in the Init, Search, Present, or Delete APDU that initiated the current operation |

4.1.1.12 Resource-Control-Response APDU

Table 18
Abstract Syntax of the Resource-Control-Response APDU

| Element | R/O/C | Value/Usage |
|-------------------|-------|---|
| PDU-Type | R | 31 = Resource-Control-Response |
| Continue-Flag | R | 1 = "continue", 2 = "do not continue" |
| Result-Set-Wanted | C | 1 = "yes", 0 = "no"; required during a search operation if value of Continue-Flag is "no"—otherwise should not be present |
| Reference-ID | C | ANY; identical to Reference-ID in the Resource-Control APDU |

4.1.2 Abstract Syntax of the Type-1 and Type-0 Queries

4.1.2.1 Type-1 Query Structure. In the definition of "query" below:

:= means "is defined as,"
 / means "or,"
 + means "followed by," and
 + has precedence over / (i.e., + is evaluated before /).

The Type-1 query is defined as follows:

query := argument / argument + argument + Operator
 argument := operand / query
 operand := Attribute-List + Term / Result-Set-ID

Attribute-List := identifier

Term := ANY

Result-Set-ID := identifier

Operator := AND / OR / AND-NOT

Notes:

1. "Query" is *recursively* defined; it is either
 - (a) "operand," or
 - (b) "argument + argument + operator."
 In case (b), each occurrence of "argument" can be replaced by either (a) or (b) and so on. A structure composed of operators and operands conforms to the Type-1 query syntax if and only if it is possible, by repeatedly replacing occurrences of (b) with (a), to reduce the structure to (a).
2. "Operand" is either (a) Attribute-List + Term, or (b) Result-Set-ID. In either case it represents a *set* of database records. For (a) it is the set of database records obtained by evaluating the specified attribute-list and term against the collection of databases specified in the search request. For (b) it is the set of database records represented by the result set for which Result-Set-ID was specified as the value of the parameter Result-Set-Name in the current or a previous Search request.
3. An example of an attribute-list for use with the Type-1 query is given in appendix C.

4.1.2.1.1 Query Evaluation. The Type-1 query is a reverse-polish-notation (RPN) structure. Evaluation of operands and operators is illustrated by the use of a stack. The query is evaluated left-to-right. Each query-term is one of the following:

- (1) Attribute-List + Term
- (2) Result-Set-ID
- (3) Operator.

Whenever (1) is encountered, it is evaluated against the collection of databases specified in the Search request, and the result is put on the stack.

Whenever (2) is encountered, it is put on the stack.

Whenever (3) is encountered, the last two items (i.e., *sets*, see note 2 above) that have been put on the stack are pulled off and the operator is applied as follows:

- if Operator is AND, the result is the intersection of the two sets,
- if Operator is OR, the result is the union of the two sets,
- if Operator is AND-NOT, the result is the set of elements in the first set which are not in the second set.

The resulting set is then put on the stack.

When evaluation of the query is complete (i.e., all query-terms have been processed) there will be one item remaining on the stack (otherwise the query is in error), which is the result of the query.

Examples:

The following examples illustrate query evaluation. In these examples, D represents the collection of databases specified in the Search request, R represents a Result-Set-ID, and A, B, and C represent attribute-list/term combinations such as "subject = dogs."

4.1.2.1.1
target has been
to the target

4.1.3 Tag 1
the data element

| Element |
|------------------------|
| PDU-Type |
| Reference-ID |
| Protocol-Version |
| Options |
| Preferred-Maximum-Size |
| Maximum-Size |
| ID/Authentication |
| Implementation |
| Implementation |
| User-Information |
| Result |
| Small-Size |
| Large-Size |

1. Query = A
Result: the records in D for which A is true
2. Query = A B C AND OR
Result: the records in D for which both B and C are true, or A is true
3. Query = A B AND C OR
Result: the records in D for which both A and B are true, or C is true
4. Query = R A AND
Result: the records in D for which both (1) A is true, and (2) which are also in result set R
5. Query = R A OR
Result: the records in D for which A is true, together with the records in result set R

4.1.2.2 Type-0 Query Structure. A Type-0 query may be used only when the origin and target have an a priori agreement outside of this standard as to the form of query acceptable to the target.

| | |
|-------|--------|
| Item | Values |
| Query | ANY |

4.1.3 Tag Values of the APDU Data Elements. Table 19 specifies tag values (integers) for the data elements of the Information Retrieval APDUs.

Table 19
Data Elements and Their Tags

| Element | Tag | PDU | R/O/C |
|------------------------|-----|---------------|-------|
| PDU-Type | 1 | (all PDUs) | R |
| Reference-ID | 2 | (all PDUs) | C |
| Protocol-Version | 3 | Init | R |
| | | Init-Response | R |
| Options | 4 | Init | R |
| | | Init-Response | R |
| Preferred-Message-Size | 5 | Init | R |
| | | Init-Response | R |
| Maximum-Record-Size | 6 | Init | R |
| | | Init-Response | R |
| ID/Authentication | 7 | Init | O |
| Implementation-ID | 8 | Init | O |
| | | Init-Response | O |
| Implementation-Name | 9 | Init | O |
| | | Init-Response | O |
| Implementation-Version | 10 | Init | O |
| | | Init-Response | O |
| User-Information-Field | 11 | Init | O |
| | | Init-Response | O |
| Result | 12 | Init-Response | R |
| Small-Set-Upper-Bound | 13 | Search | R |
| Large-Set-Lower-Bound | 14 | Search | R |

Table 19
Continued

| Element | Tag | PDU | R/O/C |
|-----------------------------|-----|---------------------------|-------|
| Medium-Set-Present-Number | 15 | Search | R |
| Replace-Indicator | 16 | Search | R |
| Result-Set-Name | 17 | Search | R |
| Database-Names | 18 | Search | O |
| Element-Set-Name | 19 | Search | O |
| | | Present | R |
| Query-Type | 20 | Search | R |
| Query | 21 | Search | R |
| Search-Status | 22 | Search-Response | R |
| Result-Count | 23 | Search-Response | R |
| Number-of-Records-Returned | 24 | Search-Response | R |
| | | Present-Response | R |
| Next-Result-Set-Position | 25 | Search-Response | R |
| | | Present-Response | C |
| Result-Set-Status | 26 | Search-Response | C |
| Present-Status | 27 | Search-Response | C |
| | | Present-Response | R |
| Database/Diagnostic-Records | 28 | Search-Response | C |
| | | Present-Response | C |
| Number-of-Records-Requested | 29 | Present | R |
| Result-Set-Start-Position | 30 | Present | R |
| Result-Set-ID | 31 | Present | C |
| | | Delete | C |
| | | Delete-Response | C |
| | | (Type-1 query) | R |
| Delete-Operation | 32 | Delete | R |
| Delete-Status | 33 | Delete-Response | C |
| Number-Not-Deleted | 34 | Delete-Response | C |
| Bulk-Statuses | 35 | Delete-Response | O |
| Delete-MSG | 36 | Delete-Response | R |
| Security-Challenge | 37 | Access-Control | R |
| Security-Challenge-Response | 38 | Access-Control-Response | R |
| Suspended-Flag | 39 | Resource-Control | O |
| Resource-Report | 40 | Resource-Control | C |
| Partial-Results-Available | 41 | Resource-Control | R |
| Continue-Flag | 42 | Resource-Control-Response | C |
| Result-Set-Wanted | 43 | Resource-Control-Response | C |
| Attribute-List | 44 | (Type-1 query) | C |
| Term | 45 | (Type-1 query) | C |
| Operator | 46 | (Type-1 query) | C |

4.2 Protocol Procedures

4.2.1 Services Required

4.2.1.1. Service Required from the Presentation Layer. The protocol uses the presentation services as defined in ISO 8822 to provide a presentation connection for communication between two information retrieval applications. The presentation services required are those contained in the presentation kernel functional unit and the session duplex functional unit. The common application association control protocol may have additional requirements for presentation services.

All Information Retrieval protocol data units will be mapped onto the P-Data service.

4.2.1.2. The common control services required are:

1) Open

2) Close

3) Abort

4) Error

5) Reset

6) Suspend

7) Resume

8) Hold

9) Release

10) Cancel

11) Acknowledge

12) Acknowledge-Response

The services Information Retrieval

It is assumed control services using the Information

4.2.2 Protocol Procedures

4.2.2.1. A service-dependent connection is

A service-dependent primitive is an

There are four

1) Open

2) Close

3) Abort

4) Error

5) Reset

6) Suspend

7) Resume

8) Hold

9) Release

10) Cancel

11) Acknowledge

12) Acknowledge-Response

Primitives implementation involving

From the For the exchange service-provider



4.2.1.2 Common Application Services Assumed. The protocol assumes the services of the common application association control service elements as defined in ISO 8649/2. The services required are:

- 1) association establishment, to allow the origin and target to establish an application association,
- 2) orderly association release, where both sides agree to the release and there is no loss of data in transit (the IR-Release service is directly mapped to this service without any Information Retrieval protocol control information), and
- 3) association abort, which allows either origin or target, at any time, to explicitly terminate the association, immediately and unconditionally. Data in transit may be lost (the IR-Abort service is directly mapped to this service without any Information Retrieval protocol control information).

The service-user will invoke the common application service elements directly. The Information Retrieval service does not invoke any common application service elements.

It is assumed that the Information Retrieval service user will handle the association control services required to establish an association with an application context encompassing the Information Retrieval service and to release or abort the association.

4.2.2 Protocol Model. To specify protocol procedure, the abstract, implementation-independent concepts of service-user, service-provider, and service primitive are used.

A service-provider provides a communication path between two service users. A service primitive is an element of interaction between the service-user and the service-provider.

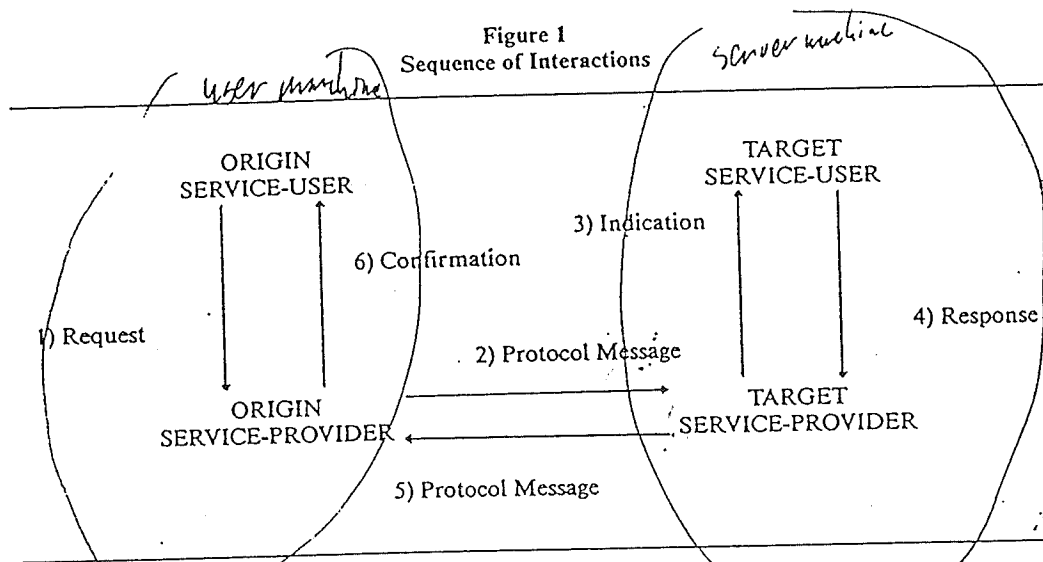
There are four types of service primitives:

- 1) Request—A primitive issued by the origin service-user to the service-provider in order to invoke some procedure
- 2) Indication—A primitive issued by the service-provider to the target service-user to indicate that a procedure has been invoked by its peer
- 3) Response—A primitive issued by the target service-user to the service-provider at the completion of the procedure previously invoked by an indication
- 4) Confirmation—A primitive issued by the service-provider to the origin service-user to complete the procedure previously invoked by a request.

Primitives are conceptual and their use neither specifies nor precludes any specific implementation of a service. Only primitives that correspond to some element of the service involving the exchange of information between systems are defined.

From the perspective of the service-user, the service-provider is system-independent. For the exchange of protocol however, a distinction is made between those portions of the service-provider residing on the origin and target systems (respectively, the origin service-provider and the target service-provider). See Figure 1. The sequence of interactions is:

- 1) Request Primitive from origin service-user to service-provider
- 2) Protocol Message from origin service-provider to target service-provider
- 3) Indication Primitive from service-provider to target service-user
- 4) Response Primitive from target service-user to service-provider
- 5) Protocol Message from target service-provider to origin service-provider
- 6) Confirmation Primitive from service-provider to origin service-user



The following illustrates the sequence of interactions which occur for a Search operation:

- 1) Search request from origin service-user to service-provider
- 2) Search APDU (Application Protocol Data Unit) from origin service-provider to target service-provider
- 3) Search indication from service-provider to target service-user
- 4) Search response from target service-user to service-provider
- 5) Search-Response APDU from target service-provider to origin service-provider
- 6) Search confirm from service-provider to origin service-user.

NOTE: The interfaces between service-user and service-provider, as represented by steps 1 and 6 for the origin, and by steps 3 and 4 for the target, are described solely to facilitate the specification of protocols. These steps do not represent intersystem communication, and therefore, the means by which they are implemented are not constrained by this specification. In an actual implementation, step 4, for example, might consist of *several* messages from the target service-user to service-provider. On the other hand, both the target service user and service-provider could be combined in a single program, in which case steps 3 and 4 might not have any real physical manifestation.

4.2.3 Search (IRPMs). The state table between the origin and the target service-user state table is more complicated state table.

The following as used in the

4.2.3 State Tables. This section defines two Information Retrieval Protocol Machines (IRPMs) in terms of state tables. One state table is defined for the origin (Table 22) and one state table is defined for the target (Table 23). Each state table shows the interrelationship between the state of an Information Retrieval association, the incoming events that occur in the protocol, the actions taken, and finally, the resulting state of the association. The IRPM state table does not constitute a formal definition of the IRPM. It is included to provide a more precise specification of the protocol procedures. The following conventions are used in state tables:

State Tables Cells

The intersection of an incoming event (row) and a state (column) forms a cell. A blank cell represents the combination of an incoming event and a state that is not defined for the IRPM. A nonblank cell represents an incoming event and state that is defined for the IRPM. Such a cell contains one or more actions, separated by semicolons (;).

Actions to be Taken by the IRPM

The IRPM state tables define the action to be taken by the IRPM in terms of one or more outgoing events (separated by semicolons) and the resulting state (in parentheses) of the Information Retrieval association.

Invalid Intersections

Blank cells indicate an invalid intersection of an incoming event and state. The state tables define correct operation only. They do not specify actions to be taken in response to incorrect operation (for example, erroneous protocol control information, incorrect protocol control actions, etc.). Such actions are not within the scope of the specification, although implementations must consider them.

Table 20
Events and Actions

The following tables list the events and actions which occur in the state tables and their abbreviations as used in the state tables:

Incoming Events—Origin
Init request
Init-Response PDU
Search request
Search-Response PDU
Present request
Present-Response PDU
Delete request
Delete-Response PDU
Resource-Control PDU
Resource-Control response
Access-Control PDU
Access-Control response
P-P-Absort indication
IR-Absort request
IR-Release request
A-Release confirm

Abbreviation
Init req
Init resp PDU
Srch req
Srch resp PDU
Prsnt req
Prsnt resp PDU
Dlte req
Dlte resp PDU
Rsc PDU
Rsc resp
Acc PDU
Acc resp
Pab ind
Iab req
Irel req
Arel conf

Table 20
Continued

Outgoing Actions—Origin

Init PDU
Init confirm
Search PDU
Search confirm
Present PDU
Present confirm
Delete PDU
Delete confirm
Resource-Control indication
Resource-Control-Response PDU
Access-Control indication
Access-Control-response PDU
IR-Abort indication
A-Abort request
A-Release request
IR-Release confirm
Save current state
Restore previously saved state

Incoming Event—Target

Init PDU
Init response
Search PDU
Search response
Present PDU
Present response
Delete PDU
Delete response
Resource-Control request
Resource-Control-Response PDU
Access-Control Request
Access-Control-Response PDU
P-P-Abort indication
IR-Abort request
A-Release indication
IR-Release response

Outgoing Action—Target

Init indication
Init-Response PDU
Search indication
Search-Response PDU
Present indication
Present-Response PDU
Delete indication
Delete-Response PDU
Resource-Control PDU
Resource-Control confirm
Access-Control PDU
Access-Control confirm
IR-Abort indication
A-Abort request
IR-Release indication
A-Release response
Save current state
Restore previously saved state

Abbreviation

Init PDU
Init conf
Srch PDU
Srch conf
Prsnt PDU
Prsnt conf
Dlte PDU
Dlte conf
Rsc ind
Rsc resp PDU
Acc ind
Acc resp PDU
lab ind
Aab req
Arel req
Irel conf
stkst
popst

Abbreviation

Init PDU
Init resp
Srch PDU
Srch resp
Prsnt PDU
Prsnt resp
Dlte PDU
Dlte resp
Rsc req
Rsc resp PDU
Acc req
Acc resp PDU
Pab ind
lab req
Arel ind
Irel resp

Abbreviation

Init ind
Init resp PDU
Srch ind
Srch resp PDU
Prsnt ind
Prsnt resp PDU
Dlte ind
Dlte resp PDU
Rsc PDU
Rsc conf
Acc PDU
Acc conf
lab ind
Aab req
Irel ind
Arel resp
stkst
popst

Origin state

1. Closed: the...
2. Init sent: the...
3. Open: the...
4. Search sent: the...
5. Prsnt sent: the...
6. Delete sent: the...
7. Rscrl sent: the...
8. Acctl sent: the...
9. Release sent: the...

Target state

1. Closed: the...
2. Init received: the...
3. Open: the...
4. Search received: the...
5. Prsnt received: the...
6. Delete received: the...
7. Rscrl sent: the...
8. Acctl sent: the...
9. Release received: the...

State

Event

Init
reqInit
resp
PDU
(ACCEPT)Init
resp
PDU
(REJECT)Srch
reqSrch
resp
PDU

Table 21
Definition of States

Origin states

1. Closed: the origin is awaiting an Init request from the application
2. Init sent: the origin has transmitted an Init APDU to the target
3. Open: the origin is awaiting a Search, Present, or Delete request
4. Search sent: the origin has transmitted a Search APDU
5. Prsnt sent: the origin has transmitted a Present APDU
6. Delete sent: the origin has transmitted a Delete APDU
7. Rscrl recvd: the origin has issued a Resource-Control indication
8. Acctl recvd: the origin has issued an Access-Control indication
9. Release sent: the origin has issued an A-Release request

Target states

1. Closed: the target is awaiting an Init APDU
2. Init recvd: the target has issued an Init indication
3. Open: the target is awaiting a Search, Present, or Delete APDU
4. Search recvd: the target has issued a Search indication
5. Prsnt recvd: the target has issued a Present indication
6. Delete recvd: the target has issued a Delete indication
7. Rscrl sent: the target has transmitted a Resource-Control APDU
8. Acctl sent: the target has transmitted an Access-Control APDU
9. Release Recvd: the target has issued an IR-rel indication.

Table 22
State Table for Origin Systems

| State | Closed 1 | Init sent 2 | Open 3 | Search sent 4 | Prsnt sent 5 | Delete sent 6 | Rscrl recvd 7 | Acctl recvd 8 | Release sent 9 |
|---------------------------------|----------------------|-------------------|--------------------|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|
| Event | | | | | | | | | |
| Init req | Init PDU (2) | | | | | | | | |
| Init resp PDU (ACCEPT) | Init conf+ (3) | | | | | | | | |
| Init resp PDU (REJECT) | Init conf- (1) | | | | | | | | |
| Srch req | | | Srch PDU (4) | | | | | | |
| Srch resp PDU | | | | | Srch conf (3) | | | | |

Table 22
Continued

| Event | State | | | | | | | | |
|----------------------|-------------|-----------------------------|---------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|---------------------|
| | Closed 1 | Init sent 2 | Open 3 | Search sent 4 | Prsnt sent 5 | Delete sent 6 | Rscrl recvd 7 | Acctrl recvd 8 | Rlease sent 9 |
| Prsnt req | | | Prsnt PDU (5) | | | | | | |
| Prsnt resp PDU | | | | | Prsnt conf (3) | | | | |
| Dlte req | | | Dlte PDU (6) | | | | | | |
| Dlte resp PDU | | | | | | Dlte conf (3) | | | |
| Rsc PDU | | Rsc ind; stkst (7) | | Rsc ind; stkst (7) | Rsc ind; stkst (7) | Rsc ind; stkst (7) | | | |
| Rsc resp | | | | | | | Rsc resp PDU; popst | | |
| Acc PDU | | Acc ind; stkst (8) | | Acc ind; stkst (8) | Acc ind; stkst (8) | Acc ind; stkst (8) | | | |
| Acc resp | | | | | | | | Acc resp PDU; popst | |
| Pab ind | | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) |
| Iab req | | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) |
| Irel req | | | Arel req (9) | | | | | | |
| Arel conf | | | | | | | | | Irel conf (1) |

Event

Init
PDUInit
resp
(ACCE: P)Init
resp
(REJE: P)Srch
PDUSrch
respPrsnt
PDUPrsnt
respDlte
PDUDlte
respRsc
req

Table 23
State Table for Target Systems

| State | | | | | | | | | |
|--------------------------|--------------------|-----------------------------|---------------------|-----------------------------|-----------------------------|-----------------------------|---------------|----------------|------------------|
| State | Closed | Init recvd | Open | Search recvd | Prsnt recvd | Delete recvd | Rscrl sent | Acctrl sent | Release recvd |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Event | | | | | | | | | |
| Init PDU | Init ind (2) | | | | | | | | |
| Init resp (ACCEPT) | | Init resp PDU(+) (3) | | | | | | | |
| Init resp (REJECT) | | Init resp PDU(-) (1) | | | | | | | |
| Srch PDU | | | Srch ind (4) | | | | | | |
| Srch resp | | | | Srch resp PDU (3) | | | | | |
| Prsnt PDU | | | Prsnt ind (5) | | | | | | |
| Prsnt resp | | | | | Prsnt resp PDU (3) | | | | |
| Dlte PDU | | | Dlte ind (6) | | | | | | |
| Dlte resp | | | | | | Dlte resp PDU (3) | | | |
| Rsc req | | Rsc PDU; stkst (7) | | Rsc PDU; stkst (7) | Rsc PDU; stkst (7) | Rsc PDU; stkst (7) | | | |

Table 23
Continued

| Event | State | | | | | | | | |
|--------------------|-------------|-----------------------------|--------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------|-----------------------|-----------------------|
| | Closed 1 | Init recvd 2 | Open 3 | Search recvd 4 | Prsnt recvd 5 | Delete recvd 6 | Rscrl sent 7 | Acctrl sent 8 | Release recvd 9 |
| Rsc resp PDU | | | | | | | Rsc conf; popst | | |
| Acc req | | Acc PDU; stkst (8) | | Acc PDU; stkst (8) | Acc PDU; stkst (8) | Acc PDU; stkst (8) | | | |
| Acc resp PDU | | | | | | | | Acc conf; popst | |
| Pab Ind | | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) | Iab ind (1) |
| Iab req | | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) | Aab req (1) |
| Arel ind | | | Irel ind (9) | | | | | | |
| Irel resp | | | | | | | | | Arel resp (1) |

4.3 Rules for
Options4.4 Configuration
compliance

4.4.1 Stack

- a) API
- b) API
- c) API
- d) API
- e) API
- f) API
- g) API
- h) API
- i) API
- j) API
- k) API
- l) API
- m) API
- n) API
- o) API
- p) API
- q) API
- r) API
- s) API
- t) API
- u) API
- v) API
- w) API
- x) API
- y) API
- z) API

4.4.2 Display

- a) API
- b) API
- c) API
- d) API
- e) API
- f) API
- g) API
- h) API
- i) API
- j) API
- k) API
- l) API
- m) API
- n) API
- o) API
- p) API
- q) API
- r) API
- s) API
- t) API
- u) API
- v) API
- w) API
- x) API
- y) API
- z) API

4.4.3 Storage

1. The following

- a) API
- b) API
- c) API
- d) API
- e) API
- f) API
- g) API
- h) API
- i) API
- j) API
- k) API
- l) API
- m) API
- n) API
- o) API
- p) API
- q) API
- r) API
- s) API
- t) API
- u) API
- v) API
- w) API
- x) API
- y) API
- z) API

2. If the system
state whether the

- a) API
- b) API
- c) API
- d) API
- e) API
- f) API
- g) API
- h) API
- i) API
- j) API
- k) API
- l) API
- m) API
- n) API
- o) API
- p) API
- q) API
- r) API
- s) API
- t) API
- u) API
- v) API
- w) API
- x) API
- y) API
- z) API

3. If the system
whether the

- a) API
- b) API
- c) API
- d) API
- e) API
- f) API
- g) API
- h) API
- i) API
- j) API
- k) API
- l) API
- m) API
- n) API
- o) API
- p) API
- q) API
- r) API
- s) API
- t) API
- u) API
- v) API
- w) API
- x) API
- y) API
- z) API

4.3 Rules for Extensibility. Unknown data elements, and unknown options within the Options data element, will be ignored on received Init APDUs.

4.4 Conformance. A system claiming to implement the procedures in this standard shall comply with the requirements in sections 4.4.1, 4.4.2, and 4.4.3.

4.4.1 Static Requirements. The system shall:

- a) act in the role of an origin (by sending Init, Search, and Present APDUs and receiving Init-Response, Search-Response and Present-Response APDUs), or target (by responding properly to Init, Search, and Present APDUs with appropriate Init-Response, Search-Response and Present-Response APDUs), or both; and,
- b) support the syntax in section 4.1; and
- c) support the Type-1 Query.

4.4.2 Dynamic Requirements. The system shall:

- a) follow all the procedures specified in sections 4.1.1, 4.1.2.1, 4.2, and 4.3;
- b) support the mapping onto the Association Control Service and Presentation Service (see 4.2.1); and
- c) assign values to APDU data elements according to the procedures described in section 3.

4.4.3 Statement Requirements.

1. The following shall be stated by the implementer:

- a) whether the system is capable of acting in the role of origin,
- b) whether the system is capable of acting in the role of target,
- c) that the system supports version 1 of this protocol.

2. If the system claims capability of acting in the role of the origin the implementor shall state whether the system:

- a) accepts Access-Control APDUs and sends Access-Control-Response APDUs,
- b) accepts Resource-Control APDUs and sends Resource-Control-Response APDUs,
- c) sends Delete APDUs and accepts Delete-Response APDUs,
- d) sends Search and Present APDUs specifying named result sets other than "default" for a result set name.

3. If the system claims capability of acting in the role of target, the implementer shall state whether the system:

- a) sends Access-Control APDUs and accepts Access-Control-Response APDUs,
- b) sends Resource-Control APDUs and accepts Resource-Control-Response APDUs,

- c) accepts Delete APDUs and sends Delete-Response APDUs,
- d) accepts Search and Present APDUs specifying named result sets other than "default" as a result set name,
- e) unilaterally deletes result sets.

4. The implementer shall state to what extent result sets may be specified as operands in a Type-1 query:

- a) whether named result sets in general, or only the default result set, may be used as an operand in a Type-1 query,
- b) whether result sets may be specified only as the first operand in a Type-1 query, or that they may be specified as any operand,
- c) with which operators (AND, OR, AND-NOT) may result sets be used as operands.

5. The implementer shall state to what extent element set names are supported in Search and Present APDUs:

- a) whether the parameter Element-Set-Names is supported,
- b) if the parameter Element-Set-Names is supported, whether database names corresponding to element set names may be specified, or only a single element set name and no corresponding database name may be specified.

6. The implementer shall state the maximum number of database names that may be specified in a Search APDU.

This is a
This is a
data unit.

A.1 Basic Set
user information
portion. This

A.1.1
integer which
part of the
A.1.2
items. The
occur, min
error. Some

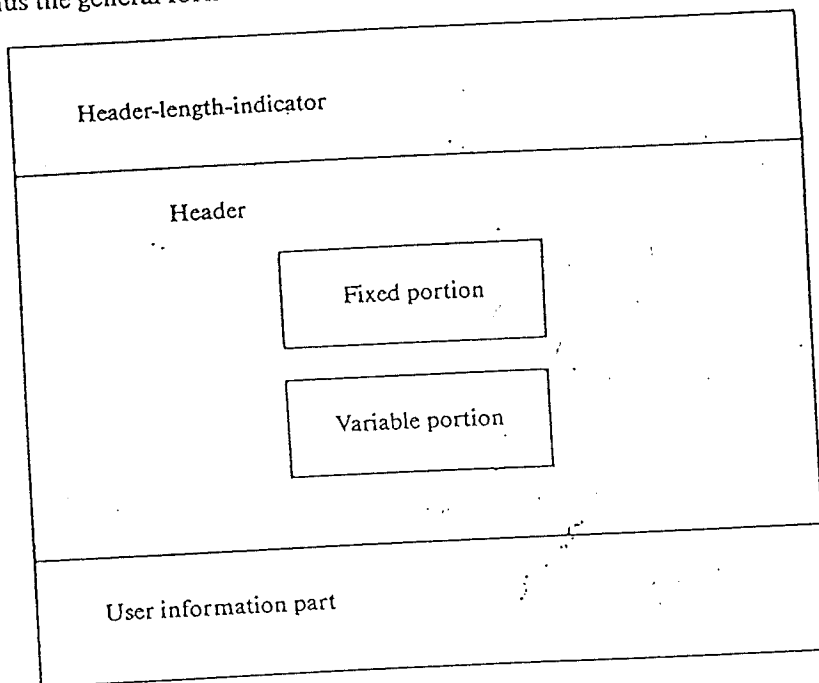
A.1.1
"variable"
identified
ifies the
Tag
occupies

Appendix A A Transfer Syntax for the Protocol Data Units

This appendix is not part of the standard but is included for information only.

This appendix specifies a default transfer syntax for the Information Retrieval protocol data units.

A.1 Basic Structure. APDUs include a header (preceded by a header-length-indicator) and a user information part. The header is composed of a fixed portion, followed by a variable portion. Thus the general format is as follows:



A.1.1 Header-Length-Indicator. The header-length-indicator is a two-byte binary integer whose value is the number of bytes in the header. The header-length-indicator is not part of the header (and therefore its value does not reflect itself).

A.1.2 Header. The fixed portion of the header consists of fixed length, fixed position items. The variable portion of the header consists of variable length items, which, if they occur, must occur in the order specified. APDUs with items occurring out of order are in error. Some of the variable length items are mandatory and some are optional.

A.1.2.1 Variable Item Formats. An item in the variable portion is referred to as a "variable item." A variable item consists of three fields: Tag, Length, and Value. "Tag" identifies the item and uniquely distinguishes it from other variable items. "Length" specifies the size (number of bytes) of "Value."

Tag is a single byte binary integer, unless the higher order bit is set, in which case it occupies two bytes, and it is evaluated as a binary integer composed of the lower seven bits of

its first byte concatenated with the lower seven bits of its second byte (the first, or leftmost byte, is higher order). Length is the same format as Tag.

Examples:

- (1) an item whose Tag is 3 and whose Value occupies two bytes

Bytes: 1 2 3 4
 00000011 00000010 xxxxxxxx xxxxxxxx

- (2) an item whose Tag is 128 and whose Value occupies 255 bytes

Bytes: 1 2 3 4 5-259
 10000001 00000000 10000001 01111111 xxxxxxxx

A.1.2.2 Tags. Specific Tag values for the data elements used in the PDUs are given in Table 19 within the standard. Note that *all* data elements used in the protocol have been assigned Tag values within the standard; however, for this particular transfer syntax not all Tag values are used. For example, elements in the fixed portion of the header are not tagged, and the elements Query and Database/Diagnostic-Records occupy the user-information-part of the PDUs in which they occur, and are not tagged.

A.1.3 User Information Part. The user information part occurs in the following APDUs:

- In the Init and Init-Response APDUs, the user information part is the element User-Information-Field, and is optional.
- In the Search APDU, the user information part is the element Query, and is mandatory.
- In the Search-Response APDU, the user information part is the element Database/Diagnostic-Records, and is a conditionally occurring field.
- In the Present-Response APDU, the user information part is the element Database/Diagnostic-Records, and is a conditionally occurring field.

All other APDUs consist entirely of the header-length-indicator and the header.

A.1.3.1 Record Identification. In the Search-Response and Present-Response APDUs, the user-information-part (if present) consists of the item Database/Diagnostic-Records, which occurs immediately following the header and consists of one or more structures of the following format:

Table A1
Record Identification

| | |
|---------------|--|
| Record type | byte 1, binary integer; The following record types are currently defined: 1 = private diagnostic record, for example, as specified in appendix D 2 = database record additional values will be added for different categories of diagnostics. |
| Record length | bytes 2 through 4; binary integer |
| Record | bytes 5,6 If Record type = 2, this field is either of two forms —delimiter database-record —database-name delimiter database-record where "database-name" identifies the database in which the record resides, and "delimiter" is the ASCII character IF (Hexadecimal). |
| | or |

A.2 APDU
only for the
applies only to
"AIR" and
portion of the
"B" and
the leftmost
byte must be

ITEM

Header-length
Header:
Fixed portion
PDU type
Variable portion
Protocol version

Options

Preferred-Max
Maximum
ID-Authentication
Implementation
Implementation
Implementation
Reference ID
User information part
User-Information

A.2 APDU Formats. In the APDU tables below, entries for "byte positions" are meaningful only for items in the fixed portion of the header. The entry for format, for variable items, applies only to the "value" portion of the item.

"ASCII" refers to an 8-bit ASCII character string, and when it occurs in the fixed portion it is left-justified and blank filled.

"Bit-map" refers to a string of N bits, where N is a multiple of eight. The leftmost bit of the leftmost byte is bit 1, there are no trailing bytes of zero, and undefined bits used to pad a byte must be set to zero.

Table A2
Init APDU

| ITEM | BYTE POSITIONS | FORMAT |
|-------------------------|-------------------|---|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Variable portion: | | |
| Protocol-version | | bit map bit 1:1 = version 1 bits 2-8: 0 |
| Options | | bit map bit 1: search bit 2: present bit 3: delete bit 4: resource control bit 5: access control |
| Preferred-Message-Size | | binary integer |
| Maximum-Record-Size | | binary integer |
| ID-Authentication | | ANY |
| Implementation-ID | | ASCII |
| Implementation-Name | | ASCII |
| Implementation-Version | | ASCII |
| Reference-ID | | ANY |
| User information part: | | |
| User-Information-Field | | ANY |

Table A3
Init-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------|-----------|-------------------------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Result | 4 | binary integer |
| Variable portion: | | (see Protocol-Version, Table A2) |
| Protocol-version | | (see Options, Table A2) |
| Options | | binary integer |
| Preferred-Message-Size | | binary integer |
| Maximum-Record-Size | | ASCII |
| Implementation-ID | | ASCII |
| Implementation-Name | | ASCII |
| Implementation-Version | | ANY |
| Reference-ID | | |
| User information part: | | ANY |
| User-Information-Field | | |

Table A4
Search APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|---------------------------|-----------|--------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Small-Set-Upper-Bound | 4-6 | binary integer |
| Large-Set-Lower-Bound | 7-9 | binary integer |
| Medium-Set-Present-Number | 10-12 | binary integer |
| Replace-Indicator | 13 | binary integer |
| Variable portion: | | ASCII |
| Result-Set-Name | | ASCII (see note 1) |
| Database-Names | | ASCII |
| Query-Type | | ASCII (see note 2) |
| Element-Set-Names | | ANY |
| Reference-ID | | |
| User information part: | | (see appendix B) |
| Query | | |

Note (1): If more than one database name is specified then the second through the last is preceded by the ASCII delimiter, 1F (hexadecimal).

Note (2): The parameter Element-Set-Names is one of the following:
 (a) delimiter 1F (hexadecimal) + a single element set name,
 (b) database name + delimiter 1F (hexadecimal) + element set name, or
 (c) more than one occurrence of (b) with the second through the last occurrence preceded by the delimiter 1E (hexadecimal).

Table A5
Search-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-----------------------------|-----------|-----------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Search-Status | 4 | binary integer |
| Result-Count | 5-7 | binary integer |
| Number-of-Records-Returned | 8-10 | binary integer |
| Next-Result-Set-Position | 11-13 | binary integer |
| Variable portion: | | |
| Result-Set-Status | | binary integer |
| Present-Status | | binary integer |
| Reference-ID | | ANY |
| User information part: | | |
| Database/Diagnostic-Records | | (see section A.1.3.1) |

Table A6
Present APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|---------------------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Number-of-Records-Requested | 4-6 | binary integer |
| Result-Set-Start-Position | 7-9 | binary integer |
| Variable portion: | | |
| Result-Set-ID | | ASCII |
| Element-Set-Names | | ASCII. See note (2) of Table A4 |
| Reference-ID | | ANY |
| User information part: (none) | | |

Table A7
Present-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|---------------------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Number-of-Records-Requested | 4-6 | binary integer |
| Result-Set-Start-Position | 7-9 | binary integer |
| Variable portion: | | |
| Result-Set-ID | | ASCII |
| Element-Set-Names | | ASCII. See note (2) of Table A4 |
| Reference-ID | | ANY |
| User information part: (none) | | |

Table A8
Delete APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|----------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Delete-Operation | 4 | binary integer |
| Variable portion: | | |
| Result-Set-ID | | ASCII |
| Reference-ID | | ANY |
| User information part: (none) | | |

Table A9
Delete-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|------------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Delete-Status | 4 | binary integer |
| Variable portion: | | |
| Result-Set-ID | | ASCII |
| Number-Not-Deleted | | binary integer |
| Bulk-Statuses | | (see note below) |
| Delete-MSG | | ASCII |
| Reference-ID | | ANY |
| User information part: (none) | | |

Note: The parameter Bulk-Statuses is one of the following:

- Result-Set-ID + delimiter 1F (hexadecimal) + status, or
- more than one occurrence of (a) with the second through the last occurrence preceded by the delimiter 1E (hexadecimal).

Table A10
Access-Control APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|----------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Variable portion: | | |
| Security-Challenge | | ANY |
| Reference-ID | | ANY |
| User information part: (none) | | |

ITEM

Header:
Fixed portion:
 PDU-Type
Variable portion:
 Security-Challenge
Reference-ID
User information part:

ITEM

Header:
Fixed portion:
 PDU-Type
 Suspended
Variable portion:
 Resource-Set-ID
 Partial-Result-Set-ID
Reference-ID
User information part:

ITEM

Header:
Fixed portion:
 PDU-Type
 Continuation-Flag
Variable portion:
 Result-Set-ID
Reference-ID
User information part:

Table A11
Access-Control-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|----------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Variable portion: | | ANY |
| Security-Challenge-Response | | ANY |
| Reference-ID | | |
| User information part: (none) | | |

Table A12
Resource-Control APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|----------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Suspended-Flag | 4 | binary integer |
| Variable portion: | | ANY |
| Resource-Report | | binary integer |
| Partial-Results-Available | | ANY |
| Reference-ID | | |
| User information part: (none) | | |

Table A13
Resource-Control-Response APDU
BYTE
POSITIONS

| ITEM | POSITIONS | FORMAT |
|-------------------------------|-----------|----------------|
| Header-Length-Indicator | 1-2 | binary integer |
| Header: | | |
| Fixed portion: | | |
| PDU-Type | 3 | binary integer |
| Continue-Flag | 4 | binary integer |
| Variable portion: | | binary integer |
| Result-Set-Wanted | | ANY |
| Reference-ID | | |
| User information part: (none) | | |

Appendix B

A Transfer Syntax for the Type-1 Query

This appendix is not part of the standard but is included for information only.

This appendix specifies a default transfer syntax for the Type-1 query as referenced in Table A4. The Type-1 query is encoded as a set of variable length items.

| ITEM | FORMAT |
|----------------|----------------------------------|
| Attribute-List | ASCII (see tables in appendix C) |
| Term | ANY |
| Result-Set-ID | ASCII |
| Operator | ASCII: |
| | a = AND |
| | o = OR |
| | n = AND-NOT |

This appendix
The attribute

C.1 Attribute

Each attribute

C.2 Attribute

USE Value Code
VALUE
ISBN
CORPORATE
ISSN
PERSONAL
SUBJECT
TITLE
GEOGRAPHIC

AUTHOR/TITLE
CODEN
SUBJECT-SUB
SERIES TITLE
MICROFORM
PLACE-OF-TITLE
NUC-CODE
LANGUAGE
COMBINATION
SYSTEM-CONT
DATE
LC-CONTROL
MUSIC-PUBLIS
GOVERNMENT
SUBJECT-CLASS
RECORD-TYPE

POSITION VALUE
VALUE
FIRST-IN-FIELD
FIRST-IN-SUB
FIRST-IN-SUB
FIRST-IN-NOT
ANY POSITION

TRUNCATION
VALUE
NO-TRUNCATION
RIGHT-TRUNCATION
PROCESS-AND
SEARCH AND

Appendix C

An Example of Attributes for Use with the Type-1 Query

This appendix is not part of the standard but is included for information only.
The attributes listed below were developed for a specific interchange implementation.

C.1 Attribute Types

Each attribute list contains each of the following attributes:

- use
- relation
- position
- structure
- truncation
- completeness.

C.2 Attribute Values

| USE Value Codes | CODE | RELATION Value Codes | CODE |
|-----------------------------|------|--------------------------|------|
| VALUE | ub | VALUE | re |
| ISBN | uc | EQUAL | rg |
| CORPORATE-NAME | us | GREATER-THAN | ro |
| ISSN | up | GREATER-THAN-OR-EQUAL | rl |
| PERSONAL-NAME | uj | LESS-THAN | rp |
| SUBJECT | ut | LESS-THAN-OR-EQUAL | rn |
| TITLE | ug | NOT-EQUAL | |
| GEOGRAPHIC NAME | ua | | |
| AUTHOR/TITLE Value Codes | ud | | |
| CODEN | ue | | |
| SUBJECT-SUBDIVISION | uf | | |
| SERIES TITLE | uh | | |
| MICROFORM-GENERATION | ui | | |
| PLACE-OF-PUBLICATION | uk | | |
| NUC-CODE | ul | | |
| LANGUAGE | um | | |
| COMBINATION-OF-USE-VALUES | un | | |
| SYSTEM-CONTROL-NUMBER | uo | | |
| DATE | ur | | |
| LC-CONTROL-NUMBER | uu | | |
| MUSIC-PUBLISHER'S-NUMBER | uv | | |
| GOVERNMENT-DOCUMENTS-NUMBER | uw | | |
| SUBJECT-CLASSIFICATION | uy | | |
| RECORD-TYPE | | | |
| POSITION Value Codes | CODE | STRUCTURE Value Codes | CODE |
| VALUE | pf | VALUE | sp |
| FIRST-IN-FIELD | ps | PHRASE | sw |
| FIRST-IN-SUBFIELD | pa | WORD | sk |
| FIRST-IN-\$a-SUBFIELD | pt | KEY | sl |
| FIRST-IN-NOT-\$a-SUBFIELD | py | WORD-LIST | |
| ANY POSITION-IN-FIELD | | | |
| TRUNCATION Value Codes | CODE | COMPLETENESS Value Codes | CODE |
| VALUE | tn | VALUE | ci |
| NO-TRUNCATION | tr | INCOMPLETE-SUBFIELD | cs |
| RIGHT-TRUNCATION | | COMPLETE-SUBFIELD | |
| PROCESS-#-INCLUDED IN | ti | COMPLETE-FIELD | cf |
| SEARCH ARGUMENT | | | |

Appendix D

An Example of a Diagnostic Record Format

This appendix is not part of the standard but is included for information only. However, implementers should be aware that it is necessary to define the format and content of some set of diagnostic records as part of the implementation for any system acting in the role of target, and this definition should be part of the implementation's documentation.

D.1. Diagnostic Record Format. The following format for diagnostic records was developed for a specific interchange implementation. It is presented here as one example of such a format. All data is ASCII.

| NAME | BYTES | VALUE |
|---------|------------------------------|---|
| LENGTH | 1,2 | $n + 3$. n = length of ADDINFO, and may be zero. |
| DIAG | 3,4 | Error condition, summarized in D.2. |
| ADDINFO | 5 to 5 + $n-1$ if present | Additional information concerning the error condition. Optional in all cases. See note [1]. |
| EOF | $n + 5$ | End of record mark (1D hex). n = length of ADDINFO and may be zero. |

D.2 Diagnostics

| VALUE | MEANING | TYPE |
|-------|--|------|
| S1 | Permanent system error | (1) |
| S2 | Temporary system error | (1) |
| S3 | Unsupported search | (2) |
| S5 | Terms only exclusion (stop) words | (2) |
| S6 | Too many argument words | (2) |
| S7 | Too many boolean operators | (2) |
| S8 | Too many truncated words | (2) |
| S9 | Too many incomplete subfields | (2) |
| SA | Truncated words too short | (2) |
| SB | Invalid format for record number (search term) | (2) |
| SC | Too many characters in search statement | (2) |
| SD | Too many records retrieved | (2) |
| SF | Present request out-of-range (see note [2]) | (3) |
| SG | System error in presenting records | (4) |
| SH | Record not authorized to be sent intersystem | (4) |
| SI | Record exceeds Preferred-message-size | (4) |
| SJ | Record exceeds Maximum-record-size | (4) |
| SK | Result set not supported as a search term | (2) |
| SL | Only <i>single</i> result set as search term supported | (2) |
| SM | Only <i>AND</i> ing of a <i>single</i> result set as search term supported | (2) |
| SN | Result set exists and replace indicator off | (2) |
| SO | Result set naming not supported | (2) |
| SP | Combination of specified databases not supported | (2) |
| SQ | Element set names not supported | (1) |
| SR | Specified element set name not valid for specified database | (1) |
| SS | Only a single element set name supported | (1) |
| ST | Result set no longer exists—unilaterally deleted by target | (1) |

SU
Sv
SW
SX
SY
SZ
T1
T2
T3
T4

TYPES: (1) ...
(2) ...
(3) ...
(4) ...

Notes:
[1] The ADDINFO field contains additional information concerning the error condition.
[2] Diagnostic records are generated when a search is performed.

| | | |
|----|---|-----|
| SU | Result set is in use | (1) |
| Sv | One of the specified databases is locked | (1) |
| SW | Terminated by negative continue response | (1) |
| SX | Specified result set does not exist | (1) |
| SY | Resources exhausted—no results available | (2) |
| SZ | Resources exhausted—unpredictable partial results available | (2) |
| T1 | Resources exhausted—valid subset of results available | (2) |
| T2 | Access-Control failure | (1) |
| T3 | Security challenge required but could not be issued—request terminated | (1) |
| T4 | Security challenge required but could not be issued—record not included | (4) |

TYPES: (1) May occur when search-status or present-status—"failure"
 (2) May occur only when search-status = "failure"
 (3) May occur only when present-status = "failure"
 (4) May occur only as a surrogate for a database record.

Notes:

[1H] The ADDINFO field is intended to provide optional diagnostic information, in text form, to an operator. Neither the content nor the format is specified. For example, for diagnostics S6, S7, S8, S9, SC, and SD, ADDINFO might contain the maximum values supported. For diagnostic SA, ADDINFO might contain the minimum size supported. For diagnostic S3, ADDINFO might specify what feature is not supported.

[2] Diagnostic SF applies when a present request is partially or wholly out-of-range, and includes the case when result-count is zero, but does not include the case where the specified result set does not exist.

6. How do you rate this standard? (circle one)

| | | | | | | | | | |
|------|----------|------|--------------|------|---------------|---|-----------|-----------|-------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Poor | Marginal | Fair | Satisfactory | Good | Above Average | | Very Good | Excellent | Outstanding |

7. How do you rate your experience and results in using this standard? (circle one)

| | | | | | | | | | |
|------|----------|------|--------------|------|---------------|---|-----------|-----------|-------------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Poor | Marginal | Fair | Satisfactory | Good | Above Average | | Very Good | Excellent | Outstanding |

8. How could this standard be improved?

9. Would you be interested in working on revisions to this standard or on other standards in the same area?

☐

Yes

☐

No

10. Other comments (You are welcome to attach additional material):

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